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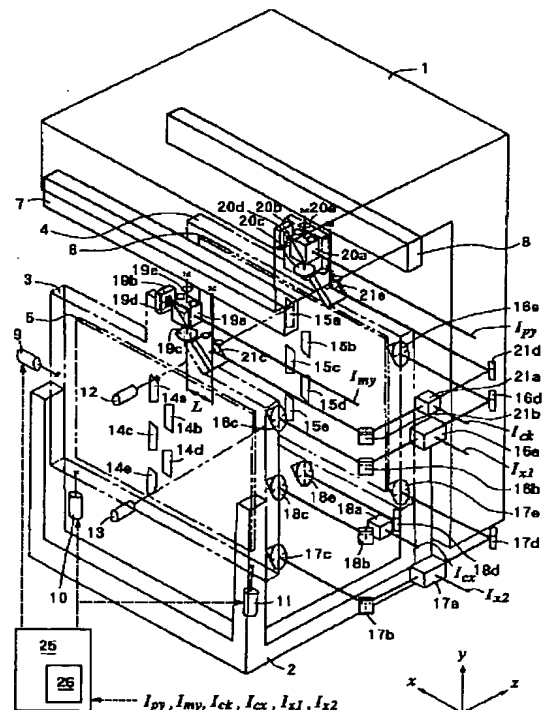
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(54)【発明の名称】 走査型露光装置及び方法

(57)【要約】

【課題】長尺鏡の面精度によらずに、高精度に走査露光することができる走査型露光装置を提供する。

【解決手段】パターンが形成されたマスク5と、パターンの像を感光基板6に投影する投影光学系と、投影光学系に対してマスクと感光基板とを同期して投影光学系の光軸と直交する第1方向yに移動させる第1移動機構とを備えた走査型露光装置において、第1方向yに沿って固設され、マスク5と対向する反射面を有した第1の反射鏡7と、第1方向yに沿って固設され、感光基板6と対向する反射面を有した第2の反射鏡8と、第1移動機構による移動に応じて、マスクと第1の反射鏡との距離を検出する第1の干渉系 I_{my} と、第1移動機構による移動に応じて、感光基板と第2の反射鏡との距離を検出する第2の干渉系 I_{py} と、両干渉系 I_{my} 、 I_{py} の検出結果に基づいて求められた、両反射面の平面度差に関するデータを記憶する記憶手段26とを設けた。



【特許請求の範囲】

【請求項1】パターンが形成されたマスクと、前記マスクのパターンの像を感光基板に投影する投影光学系と、前記投影光学系に対して前記マスクと前記感光基板とを同期して前記投影光学系の光軸と直交する第1方向に移動させる第1移動機構とを備えた走査型露光装置において、

前記第1方向に沿って固設され、前記マスクの所定の端面と対向する反射面を有した第1の反射鏡と、
前記第1方向に沿って固設され、前記感光基板の所定の端面と対向する反射面を有した第2の反射鏡と、
前記第1移動機構による前記移動に応じて、前記マスクの所定の端面と前記第1の反射鏡との距離に関する量を検出する第1の干渉系と、
前記第1移動機構による前記移動に応じて、前記感光基板の所定の端面と前記第2の反射鏡との距離に関する量を検出する第2の干渉系と、
前記第1の干渉系と前記第2の干渉系との検出結果に基づいて求められた、前記第1の反射鏡の前記反射面と前記第2の反射鏡の前記反射面との平面度差に関するデータを記憶する記憶手段とを設けたことを特徴とする走査型露光装置。

【請求項2】請求項1記載の走査型露光装置において、前記マスクと前記感光基板との少なくとも一方を前記投影光学系の光軸と前記第1方向とに直交する方向に移動する第2移動機構と、
前記第1移動機構による前記移動中に、前記記憶手段に記憶された前記データに基づいて前記第2移動機構を制御する制御手段とを設けたことを特徴とする走査型露光装置。

【請求項3】請求項1記載の走査型露光装置において、前記平面度差に関するデータは、前記固設される前の前記第1の反射鏡の前記反射面と前記第2の反射鏡の前記反射面との平面度に関するデータにより補完されていることを特徴とする走査型露光装置。

【請求項4】マスクのパターンの像を投影光学系により感光基板に投影するとともに、前記投影光学系に対して前記マスクと前記感光基板とを同期して前記投影光学系の光軸と直交する第1方向に移動させて前記マスクのパターンの像を露光する走査型露光方法において、
前記マスクの所定の端面と対向する反射面を有し前記第1方向に沿って固設された第1の反射鏡と、前記マスクの所定の端面との距離に関する量を前記移動に応じて離散的に検出する第1ステップと、
前記感光基板の所定の端面と対向する反射面を有し前記第1方向に沿って固設された第2の反射鏡と、前記感光基板の所定の端面との距離に関する量を前記移動に応じて離散的に検出する第2のステップと、
前記第1、第2ステップの検出結果に基づいて、前記第1の反射鏡の前記反射面と前記第2の反射鏡の前記反射

面との平面度差に関するデータを求めるステップとを含むことを特徴とする走査型露光方法。

【請求項5】請求項4記載の走査型露光方法において、前記平面度差に関するデータを求めるステップは、前記固設される前の前記第1の反射鏡の前記反射面と前記第2の反射鏡の前記反射面との平面度に関するデータに基づいて求められることを特徴とする走査型露光方法。

【請求項6】請求項4または請求項5記載の走査型露光方法において、

前記露光中に前記平面度差に関するデータに応じて、前記マスクと前記感光基板との少なくとも一方を前記投影光学系の光軸と前記第1方向とに直交する方向に移動するステップを含むことを特徴とする走査型露光方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は走査型露光装置に関し、特に走査途中におけるマスクステージとプレートステージとの位置ずれの補正に関する。

【0002】

【発明が解決しようとする課題】最近の液晶基板の大型化に対応するために、特願平8-184113号には、マスクの法線と走査方向との双方に直交する横方向についてのマスクとプレートとの間の相対的な位置ずれを計測するための基準となる、走査方向に延びた長尺鏡の面精度を厳しくすることなく、走査露光する技術が開示されている。しかし、この技術においては、長尺鏡に短い周期のうねりがある場合に、マスクとプレートとの間の横ずれを無視できるレベルに高精度に保つことが出来ないという不都合があった。本発明はこの問題点に鑑み、長尺鏡の面精度によらずに、高精度に走査露光することができる走査型露光装置とその手法を提供することを課題とする。

【0003】

【課題を解決するための手段】本発明は上記課題を解決するためになされたものであり、一実施例を表す図1に対応付けて説明すると、パターンが形成されたマスク(5)と、前記マスクのパターンの像を感光基板(6)に投影する投影光学系と、前記投影光学系に対して前記マスクと前記感光基板とを同期して前記投影光学系の光軸と直交する第1方向に移動させる第1移動機構とを備えた走査型露光装置において、前記第1方向に沿って固設され、前記マスクの所定の端面と対向する反射面を有した第1の反射鏡(7)と、前記第1方向に沿って固設され、前記感光基板の所定の端面と対向する反射面を有した第2の反射鏡(8)と、前記第1移動機構による前記移動に応じて、前記マスクの所定の端面と前記第1の反射鏡との距離に関する量を検出する第1の干渉系(I_{0y} 、 I_{0x} 、 I_{x1} 、 I_{x2})と、前記第1移動機構による前記移動に応じて、前記感光基板の所定の端面と前記第2の反射鏡との距離に関する量を検出する第2の干渉系

(I_{py} 、 I_{ck} 、 I_{x1} 、 I_{x2})と、前記第1の干渉系と前記第2の干渉系との検出結果に基づいて求められた、前記第1の反射鏡の前記反射面と前記第2の反射鏡の前記反射面との平面度差に関するデータを記憶する記憶手段(26)とを設けたことを特徴とする走査型露光装置である。

【0004】本発明はまた、マスク(5)の 패턴の像を投影光学系により感光基板(6)に投影するとともに、前記投影光学系に対して前記マスクと前記感光基板とを同期して前記投影光学系の光軸と直交する第1方向に移動させて前記マスクの图案の像を露光する走査型露光方法において、前記マスクの所定の端面と対向する反射面を有し前記第1方向に沿って固設された第1の反射鏡(7)と、前記マスクの所定の端面との距離に関する量を前記移動に応じて検出する第1ステップと、前記感光基板の所定の端面と対向する反射面を有し前記第1方向に沿って固設された第2の反射鏡(8)と、前記感光基板の所定の端面との距離に関する量を前記移動に応じて検出する第2のステップと、前記第1、第2ステップの検出結果に基づいて、前記第1の反射鏡の前記反射面と前記第2の反射鏡の前記反射面との平面度差に関するデータを求めるステップとを含むことを特徴とする走査型露光方法である。

【0005】

【発明の実施の形態】本発明の実施の形態を図面を用いて説明する。図1に本発明による走査型露光装置の一実施例の概略構成を示す。以下の説明では、走査方向、すなわち縦方向をx軸とし、マスク5と同一面内においてx軸に直交する横方向をy軸とし、マスク5の法線方向をz軸とする座標系をとっている。超高圧水銀ランプ等の光源(不図示)から射出された照明光は、光ファイバー等(不図示)を介して、5つ照明光学系(不図示)に導かれる。各照明光学系は、それぞれフライアイレンズ、視野絞り等(不図示)を含んで構成される。各照明光学系から射出されたそれぞれの照明光は、マスク5上の異なる照明領域14a~14eを均一に照明する。マスク5を通過した各光束は、それぞれ等倍正立の結像を行う5つの投影レンズ部を有した投影光学系PL(図9参照)を介して、感光基板であるプレート6上の異なる露光領域15a~15eを露光し、こうしてマスク5上の照明領域14a~14eの图案の像をプレート6上に結像する。各照明領域14a~14eはそれぞれ分離して配置されているが、各照明領域14a~14eのx方向の幅をx方向に積算した積算幅は、同一の幅を持ってy方向に連続するように形成されている。

【0006】各照明光学系と各投影光学系は、架台1によって支持されている。架台1には、駆動装置(不図示)によってx方向に走行駆動されるキャリッジ2が搭載されており、このキャリッジ2に、マスクステージ3とプレートステージ4とが保持されている。マスクステ

ージ3にはマスク5が保持されており、プレートステージ4にはプレート6が保持されており、こうしてキャリッジ2をx方向に走査することにより、マスク5上の图案の全体がプレート6上に転写される。マスクステージ3は、微動機9~11を介してキャリッジ2に支持されており、すなわちx方向微動機9によってマスクステージ3のx方向の位置を微動し、y方向微動機10、11によってマスクステージ3のy方向の位置とz軸回りの回転方向とを微動できるように構成されている。

【0007】一方、プレートステージ4は、プレート6の厚みムラや傾きの影響を補正し、同時にマスク图案の結像面に一致させるために、3つ以上のz方向微動機(不図示)を介してキャリッジ2に支持されており、こうしてz方向の微動(オートフォーカス)と、x軸回り及びy軸回りの傾斜角度(オートレベリング)を調節できるように構成されている。また架台1には、マスク用長尺鏡7とプレート用長尺鏡8が固定されている。両長尺鏡7、8はx方向に長く延びた反射鏡であり、その反射面の法線はy方向を向いている。マスク用長尺鏡7はマスクステージ3に対向して配置され、プレート用長尺鏡8はプレートステージ4に対向して配置されている。

【0008】図9は、図1の走査型露光装置を部分的に表わした斜視図である。投影光学系PLは、照明領域14a~14eのそれぞれの領域を通過した光束をプレート6に投影するため千鳥状に配置された5つの投影レンズ部を有している。なお、図9では5つの投影レンズ部を代表して投影光学系PLと表わしており、また、投影光学系PLの光軸をAXと示している。図9から明らかなように、マスク用長尺鏡7とプレート用長尺鏡8とは、投影光学系PLの光軸AXと直交する第1の方向であるX方向に沿って配設されている。

【0009】図1に戻ってマスクステージ3とプレートステージ4の位置と姿勢は、次のように6つの干渉計 I_{x1} 、 I_{x2} 、 I_{cx} 、 I_{cy} 、 I_{py} 及び I_{ck} によって監視されている。まず差動型干渉計 I_{x1} は、マスクステージ3とプレートステージ4とのx方向の相対的な位置ずれ(縦ずれ)を計測するためのものである。すなわち架台1に固定されたレーザー光源(不図示)から射出されたレーザー光束は、架台1に固定されたビームスプリッタ16aにより分割され、分割された各光束は、それぞれ架台1に固定された反射鏡16b、16dで反射し、それぞれマスクステージ3とプレートステージ4とに固定された反射鏡16c、16eで反射し、往路を逆進してビームスプリッタ16aで合成されて干渉し、干渉計 I_{x1} のレーザ(不図示)に入射する。

【0010】差動型干渉計 I_{x2} は、干渉計 I_{x1} とはy方向に異なる位置において、マスクステージ3とプレートステージ4とのx方向の相対的な位置ずれ(縦ずれ)を計測するためのものである。すなわち干渉計 I_{x2} 用のレ

ーザー光束は、ビームスプリッタ17aにより分割され、分割された各光束は、それぞれ反射鏡17b, 17dで反射し、それぞれマスクステージ3とプレートステージ4とに固定され反射鏡17c, 17eで反射し、往路を逆進してビームスプリッタ17aで合成され、干渉計 I_{x2} のレシーバに入射する。なお、マスクステージ3に固定した反射鏡16cと17cとの間隔と、プレートステージ4に固定した反射鏡16eと17eとの間隔は等しく、以降この間隔をHとする。マスクステージ3上の反射鏡16c、17c及びプレートステージ4上の反射鏡16e、17eの位置は、各ステージ3, 4の中心から等距離にあることが望ましい。

【0011】測長型干渉計 I_{cx} は、キャリッジ2の移動距離を計測するためのものである。すなわち干渉計 I_{cx} 用のレーザー光束は、ビームスプリッタ18aにより分割され、分割された各光束は、それぞれ架台1に固定された反射鏡18b, 18dで反射し、一方の光束はマスクステージ3上に固定された反射鏡18cで反射し、他方の光束は投影光学系に固定された固定鏡18eで反射し、両光束は往路を逆進してビームスプリッタ18aで合成されて干渉し、干渉計 I_{cx} のレシーバに入射する。こうして干渉計 I_{cx} によって、マスクステージ3と固定鏡18eとのx方向の距離が計測される。

【0012】測長型干渉計 I_{my} は、マスクステージ3とマスク用長尺鏡7とのy方向の距離を計測するためのものである。また測長型干渉計 I_{py} は、プレートステージ4とプレート用長尺鏡8とのy方向の距離を計測するためのものである。両干渉計 I_{my} , I_{py} は同様の構成であるので、干渉計 I_{my} についての説明をかつこ外に記載し、干渉計 I_{py} についての説明をかつこ内に記載する。すなわち干渉系 I_{my} (I_{py}) 用のレーザ光束はマスクステージ3 (プレートステージ4) に固定されたビームスプリッタ19a (20a) により2つの光束に分割される。この2つの光束の内のビームスプリッタ19a (20a) を透過した光束は、マスクステージ3 (プレートステージ4) 上に配設された $\lambda/4$ 板19d (20d) を通り、マスクステージ3 (プレートステージ4) 上に配設された反射鏡19b (20b) で反射し、再び $\lambda/4$ 板19d (20d) を通る。 $\lambda/4$ 板19d (20d) を通った光束は、ビームスプリッタ19a (20a) と、マスクステージ3 (プレートステージ4) 上に配設されたコーナキューブ19c (20c) と、ビームスプリッタ19a (20a) とをそれぞれ反射して $\lambda/4$ 板19d (20d) を通り反射鏡19b (20b) で反射し、 $\lambda/4$ 板19d (20d)、ビームスプリッタ19a (20a) をそれぞれ通り干渉系 I_{my} (I_{py}) のレシーバに入射する。

【0013】ビームスプリッタ19a (20a) により分割された光束の内のビームスプリッタ19a (20a) で上方に反射された光束は、 $\lambda/4$ 板19e (20

e) を通り長尺鏡7 (8) で反射し、 $\lambda/4$ 板19e (20e) とビームスプリッタ19a (20a) とをそれぞれ通りコーナキューブ19c (20c) で反射する。コーナキューブ19c (20c) で反射された光束は、ビームスプリッタ19a (20a) と $\lambda/4$ 板19e (20e) とをそれぞれ通り、長尺鏡7 (8) で反射して、 $\lambda/4$ 板19e (20e) を通りビームスプリッタ19a (20a) で反射されて干渉系 I_{my} (I_{py}) のレシーバに入射する。これにより、ビームスプリッタ19a (20a) により2つの光束に分割された光束は、再びビームスプリッタ19a (20a) で合成されて干渉してレシーバに入射する。

【0014】差動型干渉計 I_{ck} は、両長尺鏡7, 8を介して、マスクステージ3とプレートステージ4とのy方向の相対的な位置ずれを計測するためのものである。すなわち干渉計 I_{ck} 用のレーザー光束は、ビームスプリッタ21aにより分割され、分割された各光束は、それぞれ架台1に固定された反射鏡21b, 21dで反射し、一方の光束はマスクステージ3上の反射鏡21cで反射し、マスク用長尺鏡7で反射する。他方の光束はプレートステージ4上の反射鏡21eで反射し、プレート用長尺鏡8で反射する。両光束は往路を逆進してビームスプリッタ21aで合成されて干渉し、干渉計 I_{ck} のレシーバに入射する。なお、マスクステージ3に固定したコーナキューブ19cと反射鏡21cとのx方向の間隔と、プレートステージ4に固定したコーナキューブ20cと反射鏡21eとのx方向の間隔は等しく、以降この間隔をLとする。

【0015】キャリッジ2の位置をxとし、マスクステージ3とプレートステージ4とのx方向の相対的な位置ずれ量 (縦ずれ量) を $\Delta X(x)$ とし、y方向の相対的な位置ずれ量 (横ずれ量) を $\Delta Y(x)$ とし、z軸回りの相対的な角度ずれ量を $\Delta T(x)$ とする。また両長尺鏡7, 8の平面度差を $\Delta h(x)$ とする。平面度差 Δh とは、マスク用長尺鏡7の反射面とプレート用長尺鏡8の反射面とのy方向の相対的な位置ずれ量 (横ずれ量) である。各干渉計 I_{x1} , I_{x2} , I_{cx} , I_{my} , I_{py} , I_{ck} の計測値をそれぞれ同じ文字を用いて、 I_{x1} , I_{x2} , I_{cx} , I_{my} , I_{py} , I_{ck} と表すと、

$$\Delta X(x) = (I_{x1} + I_{x2}) / 2 \quad \cdots (1)$$

$$\Delta T(x) = (I_{x1} - I_{x2}) / H \quad \cdots (2)$$

$$\Delta Y(x) = I_{my} - I_{py} - \Delta h(x) \quad \cdots (3)$$

となる。

【0016】上記(1)～(3)式のうち、(1)式の縦ずれ ΔX と(2)式の角度ずれ ΔT の値は、干渉計 I_{x1} , I_{x2} の計測値から直ちに得られる。また(3)式の横ずれ ΔY については、平面度差 Δh がキャリッジ2の位置xの関数として、制御装置25内の記憶装置26内に格納されており、この $\Delta h(x)$ と干渉計 I_{my} , I_{py} の計測値とから、横ずれ ΔY を求めている。こうしてx

-y 面内での縦ずれ ΔX と横ずれ ΔY と角度ずれ ΔT に対して、制御装置 25 によって微動機 9～11 を駆動し、マスクステージ 3 の位置を x-y 面内で微調整することにより、走査露光時のマスクステージ 3 とプレートステージ 4 との相対的な位置関係を一定に保っている。

【0017】以下に、両長尺鏡 7, 8 の平面度差 $\Delta h(x)$ の求め方について説明する。この平面度差 $\Delta h(x)$ は、各長尺鏡 7, 8 自体の鏡面形状と、各長尺鏡 7, 8 の架台 1 への取り付け姿勢に依存する。本実施例は、一方において各長尺鏡 7, 8 自体の鏡面形状を連続的に測定し、他方において各長尺鏡 7, 8 を架台 1 に取り付けたときの平面度差 $\Delta h(x)$ を離散的に測定し、しかる後に離散的に求められた平面度差 Δh の各区間内を、両長尺鏡 7, 8 の連続的な形状の差で補間することにより、平面度差 Δh を x の連続関数として求めるものである。

【0018】そこで先ず、各長尺鏡 7, 8 自体の鏡面形状を連続的に求める方法について説明する。図 2 は各長尺鏡 7, 8 の面精度を連続的に計測するための概要を示した図である。この計測は架台 1 への組み込み前、例えば、長尺鏡 7, 8 の研磨終了時に、面精度の確認と計測を兼ねて行うのが効率的である。また計測時の長尺鏡 7, 8 の姿勢は、架台 1 に組み込んだときの姿勢と同一とすることが望ましい。

【0019】レーザー光源 30 から射出されたレーザー光束は、ビームエキスパンダ 31 により光径を広げられ、レンズ 32 を通り平行光線となる。次いでレーザー光はハーフミラー 33 を透過し、透過光の一部はフィゾー素子の最終面に設けた参照面 35 で反射し、往路を逆進してハーフミラー 33 に戻る。参照面 35 の裏面 34 には反射防止膜がコーティングされている。他方、参照面 35 を透過したレーザー光は、マスク用長尺鏡 7 (又はプレート用長尺鏡 8) で反射し、往路を逆進してハーフミラー 33 に戻る。参照面 35 で反射したレーザー光と長尺鏡 7 (8) で反射したレーザー光は干渉し、ハーフミラー 33 で反射し、検出器 36 に達する。こうして検出器 36 によって参照面 35 に対する長尺鏡 7 (8) の面精度を計測することができ、すなわち長尺鏡 7

(8) の任意の点における平面度を求めることが可能となる。

【0020】なお液晶基板の大型化に伴い、長尺鏡 7 (8) は長くなることが予想されるが、参照面 35 よりも長くなった場合には、長尺鏡 7 (8) をずらして複数回の測定を行うことにより、全面を計測することができる。ただし、この場合、後述する干渉計 I_{ny} 、 I_{py} 、 I_{ck} による計測点をオーバーラップさせて計測する必要がある。また図 2 では長尺鏡 7 (8) の面精度の計測にフィゾー干渉計を用いているが、計測方法はこれに限られたものではない。

【0021】次に長尺鏡の平面度差を離散的に計測する

方法について説明する。計測はキャリッジ 2 を走査しながら、一定の計測間隔 L ごとに計測する。計測終了までは、マスクステージ 3 とプレートステージ 4 は相対的に固定し、すなわち微動機 9～11 は駆動しない。計測を行う間隔 L は、干渉計 I_{ny} 又は干渉計 I_{py} の光束が長尺鏡 7 又は長尺鏡 8 で反射する位置と、干渉計 I_{ck} の光束が長尺鏡 7 又は長尺鏡 8 で反射する位置との x 方向の間隔とする。計測は次のように行う。長尺鏡 7, 8 の一端にキャリッジ 2 を移動したときの干渉計 I_{ny} 、 I_{py} 、 I_{ck} の値を計測する。次いでキャリッジ 2 の位置を干渉計 I_{cx} で計測しながら、キャリッジ 2 の位置を L だけ移動し、その位置で干渉計 I_{ny} 、 I_{py} 、 I_{ck} の値を計測する。以下同様に、キャリッジ 2 の位置を L だけ移動することにより、干渉計 I_{ny} 、 I_{py} 、 I_{ck} の値を計測する。

【0022】以下簡単のために、長尺鏡上の離散的な計測位置 i における干渉計 I_{ny} 、 I_{py} 、 I_{ck} の計測値をそれぞれ $I_{ny}(i)$ 、 $I_{py}(i)$ 、 $I_{ck}(i)$ と表記する。すなわち離散的な位置を意味するときには変数 i を使用し、連続的な位置を意味するときには変数 x を使用する。なお明らかに、同一のキャリッジ 2 の位置において計測されるのは、 $I_{ny}(i)$ 、 $I_{py}(i)$ 、 $I_{ck}(i-1)$ である。また、計測開始位置での干渉計の値を $I_{ny}(1)$ 、 $I_{py}(1)$ 、 $I_{ck}(0)$ とする。

【0023】干渉計 I_{ny} は、マスクステージ 3 とマスク用長尺鏡 7 との y 方向の距離を計測しており、干渉計 I_{py} は、プレートステージ 4 とプレート用長尺鏡 8 との y 方向の距離を計測している。したがってこれらの両干渉計 I_{ny} 、 I_{py} の計測値には、両長尺鏡 7, 8 の平面度差 Δh 以外に、キャリッジ 2 のローリング誤差 (x 軸回りの回転) と、干渉計リセット時のオフセットが含まれる。計測位置 i における両長尺鏡の平面度差を $\Delta h(i)$ とし、ローリング量を $r(i)$ とし、両干渉計 I_{ny} 、 I_{py} のリセット時のオフセットをそれぞれ A 、 B とする。

【0024】両干渉計 I_{ny} 、 I_{py} の計測値の差として $I_y(i)$ を新たに、

$$I_y(i) \equiv I_{ny}(i) - I_{py}(i) \quad \cdots (4)$$

と定義すると、次式が成り立つ。

$$I_y(i) \equiv I_{ny}(i) - I_{py}(i) = \Delta h(i) + r(i) + A - B \quad \cdots (5)$$

(5) 式中、 $I_y(i)$ は測定値であり、右辺は未知である。

【0025】また干渉計 I_{ck} は、両長尺鏡 7, 8 を介して、マスクステージ 3 とプレートステージ 4 との y 方向の位置ずれを計測している。したがって干渉計 I_{ck} の計測値には、両長尺鏡 7, 8 の平面度差 Δh と、キャリッジ 2 のローリングに起因する誤差 r と、干渉計リセット時のオフセット C のほかに、更に、マスクステージ 3 とプレートステージ 4 との縦ずれ ΔX と、 z 軸回りの角度ずれ ΔT に起因する位置ずれが含まれる。また同時に計

測された干渉計 I_{my} 、 I_{py} 、 I_{ck} の計測値に含まれるローリング量は等しい。したがって $I_{ck}(i-1)$ は次式

$$I_{ck}(i-1) = \Delta h(i-1) + r(i) + C + \Delta X(i-1) + \Delta T(i-1) \cdot H \quad \cdots (6)$$

【0026】縦ずれ ΔX と角度ずれ ΔT は測定値である (8) 式となる。

から、 I_{ck}' を (7) 式で定義すると、(6) 式は

$$I_{ck}'(i) \equiv I_{ck}(i) - \Delta X(i) - \Delta T(i) \cdot H \quad \cdots (7)$$

$$I_{ck}'(i-1) = \Delta h(i-1) + r(i) + C \quad \cdots (8)$$

(8) 式中、 $I_{ck}'(i-1)$ は測定値であり、右辺は未知である。

誤差 r を消去するために、 ΔH を (9) 式で定義すると、 ΔH は (5) 式と (8) 式から (10) 式のように

【0027】更に、キャリッジ2のローリングに起因する。

$$\Delta H(i) \equiv I_y(i) - I_{ck}'(i-1) \quad \cdots (9)$$

$$\Delta H(i) = \Delta h(i) - \Delta h(i-1) + A - B - C \quad \cdots (10)$$

(10) 式中、 $\Delta H(i)$ は干渉計 I_{my} 、 I_{py} 、 I_{ck} 、 I_{x1} 、 I_{x2} の計測値から求められ、右辺は未知である。

までの和を $S(k)$ とし、長尺鏡の位置 k を新たに位置 i と標記すると、

【0028】 $\Delta H(i)$ の $i=1$ から $i=k$ ($k \geq 1$)

$$S(i) \equiv \Delta H(1) + \Delta H(2) + \cdots + \Delta H(i) \quad \cdots (11a)$$

$$\begin{aligned} S(i) &= \Delta h(1) - \Delta h(0) + A - B - C \\ &\quad + \Delta h(2) - \Delta h(1) + A - B - C \\ &\quad + \cdots + \\ &\quad + \Delta h(i) - \Delta h(i-1) + A - B - C \\ &= \Delta h(i) - \Delta h(0) + (A - B - C) \times i \quad (i \geq 1) \end{aligned} \quad \cdots (11b)$$

となる。(11b) 式中、 $S(i)$ は測定値であり、右辺は未知である。かくして (11b) 式より、位置 i に

おける長尺鏡の平面度差 $\Delta h(i)$ は、

$$\Delta h(i) = S(i) + \Delta h(0) - (A - B - C) \times i \quad (i \geq 1) \quad \cdots (12)$$

となる。 $i=0$ のとき $S(0) \equiv 0$ とおくと、 $i=0$ のときも (12) 式が成り立つ。

【0029】(12) 式の右辺中、 $S(i)$ は測定値であり、 $\Delta h(0)$ と $(A - B - C) \times i$ が未知数である。このうち、 $\Delta h(0)$ は長尺鏡の計測位置 i に拘らず常に一定のオフセットであるから、(3) 式より明らかなように、マスクステージ3とプレートステージ4との間の横ずれ量 $\Delta Y(x)$ は変化せず、すなわちマスクステージ3とプレートステージ4とのアライメントをすることにより誤差とならない。一方、 $(A - B - C) \times i$ は長尺鏡の位置 i に依存して線形に変化するから、その係数 $(A - B - C)$ を求める必要がある。そこで次に係数 $(A - B - C)$ の求め方を示す。

【0030】先ず第1工程として、(12) 式中の $S(i)$ を測定するために、キャリッジ2を走査して各干渉計の計測値を測定する。このとき既述のごとく、マスクステージ3とプレートステージ4との間の縦ずれ量 ΔX は (1) 式によって連続的に計測され、 $x-y$ 面内の角度ずれ量 ΔT は (2) 式によって連続的に計測されるから、これらのずれ量 ΔX 、 ΔT を一定に保ちながら、キャリッジ2を走査することができる。しかし横ずれ量 ΔY は、平面度差 $\Delta h(x)$ が未知であるのみならず、その離散値 $\Delta h(i)$ も未知であるから、横ずれ量

ΔY を一定に保つことはできない。そこで先ず、横ずれの調整は全く行わずにキャリッジ2を走査し、そのときの $x=0, L, 2 \times L, \cdots, i \times L, \cdots$ での干渉計 I_{my} 、 I_{py} の計測値 $I_{my}(i)$ 、 $I_{py}(i)$ を測定する。次いで第2工程として、(11a) 式によって $S(i)$ を求める。

【0031】次いで第3工程として、(12) 式中の $(A - B - C)$ を求めるために、図3に示す誤差計測用のマスク40をマスクステージ3にセットし、誤差計測用のプレートをプレートステージ4にセットして、1回目の走査露光を行う。但し、(12) 式中の $S(i)$ は既知となったが、係数 $(A - B - C)$ は未知であるために、この係数 $(A - B - C)$ を無視し、すなわち両長尺鏡の平面度差の暫定式として、

$$\Delta h(i) = S(i) \quad \cdots (13)$$

を用いる。また、 i は離散値であるから $\Delta h(i)$ と $\Delta h(i+1)$ の間を、1次式で補間する。すなわち計測位置 i と干渉計 I_{cx} で計測されるキャリッジ2の位置 x との関係は、計測開始位置における干渉計 I_{cx} の値を0とすると、次式で表される。

$$x = i \times L \quad \cdots (14)$$

【0032】したがって、キャリッジ2が長尺鏡上の計測位置 i と $i+1$ との間にあるときの両長尺鏡の平面度

差の暫定式 $\Delta h(x)$ は、次式で表される。

$$\Delta h(x) = [\Delta h(i+1) - \Delta h(i)] \times (x/L - i) + \Delta h(i) \quad \dots (15)$$

かくして(13)式と(15)式によって両長尺鏡の平面度差の暫定値が連続的に得られるから、(3)式によってマスクステージ3とプレートステージ4との間の横ずれ量 ΔY を求め、この横ずれ量 ΔY を一定に保ちながらキャリッジ2を走査する。

【0033】図3は誤差計測用のマスク40を示し、このマスク40にはx方向に1列に、またy方向には間隔Lごとに、複数のマーク41が描画されている。マーク41のy方向の間隔は、両長尺鏡の離散的平面度計測における計測間隔Lと一致させることが好ましい。図4は1つのマーク41の拡大図を示しており、露光位置検出用のパターンである。同図において斜線部は遮光領域であり、十文字状の部分が透光領域である。ここでは露光位置検出用に十字マークを用いたが、露光位置が検出できるマークであればどのようなマークでもかまわない。また、誤差検出用マスク40には、一对のマスク用アライメントマーク42、43と、一对のプレート用アライメントマーク44、45が描画されている。両マーク42、43；44、45は、図3に示すように、x方向とy方向との双方に若干ずらして配置されている。

【0034】マスク40の走査露光の後に、プレートを現像する。プレート48には、図5に示すように、複数のマーク41の転写マーク49のほかに、マスク用アライメントマーク42、43の転写マーク(不図示)と、プレート用アライメントマーク44、45の転写マーク46、47が転写される。次いでマスク40とプレートを共に90度回転させて、それぞれマスクステージ3とプレートステージ4にセットし、マスク40上のマスク用アライメントマーク42、43と、プレート48上のプレート用アライメントマーク転写マーク46、47とのアライメントを行う。すなわち両マーク42、43；46、47の相対的な位置誤差をアライメント顕微鏡12、13により計測し、微動機9～11を駆動して、両マーク42、43；46、47の位置を合わせ、しかる後に2回目の露光を行う。

【0035】マスク40上のマスク用アライメントマーク42、43と、プレート用アライメントマーク44、45とは、x、y方向に若干ずれて配置されており、2回目の露光時には、マスク用アライメントマーク42、43と、プレート用アライメントマークの転写マークとを位置合わせした。したがって1回目の露光と2回目の露光との間では、マスク用アライメントマーク42、43とプレート用アライメントマーク44、45との間隔だけ、マスク40とプレート48とをずらして露光したことになる。

【0036】この結果、2回の露光によって得られる複数のマーク41の像49は、図6に示すように、十字マ

ークが2つある像となる。両方の十字マークの間隔を顕微鏡等で計測し、この測定値から、マスク40とプレート48との位置ずれ量を差し引くことにより、両方の十字マークの間の正味のずれ量を知ることができる。ここで微動機9～11の制御は、x方向には正確に制御しており、y方向には暫定式によって制御している。したがってマーク41とその像との間には、x方向にはずれがなく、y方向には暫定式によって制御したことによる誤差だけ位置ずれを生じる。すなわち1回目の露光において、マーク41とその像との間にはx方向にずれはなく、2回目の露光時には90度回転していたから、2回目の露光時の配置についていえば、マーク41とその1回目の像との間には、y方向にずれがない。また、2回目の露光時の配置について、マーク41とその2回目の像との間には、y方向に暫定式によって制御したことによる誤差だけ位置ずれを生じる。したがって両方の十字マークの間のy方向の正味のずれ量を計測することにより、暫定式によって制御したことによる誤差を知ることができる。

【0037】次いで第4工程として、係数(A-B-C)を求める。図7は横軸にマーク41の位置iを取り、縦軸にy方向、すなわち横方向の正味の位置ずれ量をプロットした図である。横方向の正味の位置ずれ量は、

$$-\Delta h(0) + (A-B-C) \times i \quad \dots (16)$$

となるから、図7のプロットした点から回帰直線50を求めると、その勾配が係数(A-B-C)となる。かくして(12)式より、両長尺鏡の離散的な平面度差 $\Delta h(i)$ を求めることができる。

【0038】なお、第3工程における微動機の制御は、 $S(i)$ を測定した各計測点においては、 $(A-B-C) \times i$ を無視している点を除いて正しい制御が行われている。したがって正味の横ずれ量を測定する計測点は、 $S(i)$ を求めたときの計測点と一致させることが好ましい。なぜならば、 $S(i)$ を求めたときの計測点以外の点で正味の横ずれ量を測定すると、 $(A-B-C) \times i$ 以外の要素が加わるおそれがあるからである。正味の横ずれ量を測定する計測点と、 $S(i)$ を求めたときの計測点とを一致させるためには、先ずマーク41の間隔を、 $S(i)$ を求めたときの計測間隔Lと一致させる必要がある。次いで計測点自体を一致させるために、キャリッジ2の走査方向の基準位置を決める際に、2回目の露光の配置でマスク40をセットし、マスク40上のマーク41が露光位置に一致するところから、Lの整数倍でキャリッジを移動したところを基準位置とすれば良い。なお当然に、1回目の露光と2回目の露光との順序を逆転しても良い。

【0039】またこのように正味の横ずれ量を測定する計測点と、 $S(i)$ を求めたときの計測点とを一致させたときには、各計測点の中間位置での微動機の制御は、特に問題とならない。したがって本実施例では各計測点の間を単に線形に補間したが、例えば、各計測点の間を、両長尺鏡の実際の平面度差によって補間することもできる。このように各計測点の間を、両長尺鏡の実際の平面度差によって補間する手法は、正味の横ずれ量を測定する計測点と、 $S(i)$ を求めたときの計測点とを一致させることが困難なときに、有効である。

【0040】また、2回の露光によってy方向の位置ずれを離散的に計測する方法に代えて、露光を行わずに、次のようにしてy方向の位置ずれを離散的に計測することもできる。すなわち図8(a)と(b)に示すように、誤差計測用のマスク60とプレート61のy方向の一端側に、それぞれ複数のアライメントマーク62とアライメントマーク63を間隔Lでx方向に配置し、y方向の他端側に、それぞれアライメントマーク62bとアライメントマーク63bを配置する。このマスク60とプレート61をそれぞれマスクステージとプレートステージにセットし、マスク60上の複数のアライメントマーク62のうちの1つのアライメントマーク62aと、プレート61上の複数のアライメントマーク63のうちの1つのアライメントマーク63aをアライメントし、マスク60上のアライメントマーク62bと、プレート61上のアライメントマーク63bをアライメントすることにより、マスク60とプレート61の位置決めを行う。

【0041】次いで縦ずれ量 ΔX は(1)式によって正確に制御し、x-y面内での角度ずれ量 ΔT は(2)式によって正確に制御し、横ずれ量 ΔY は、(13)式と

$$\Delta h(i) = \Delta k(x) + \text{sft}(i) + \text{mag}(i) \times (x - i \times L) \\ [i \times L \leq x \leq (i+1) \times L] \quad \cdots (17)$$

となる。

$$\Delta h(i) = \Delta k(i \times L) + \text{sft}(i) \quad \cdots (18)$$

であり、 $x = (i+1) \times L$ において、

$$\Delta h(i+1) = \Delta k((i+1) \times L) + \text{sft}(i) + \text{mag}(i) \times L \\ \cdots (19)$$

であるから、

$$\text{sft}(i) = \Delta h(i) - \Delta k(i \times L) \quad \cdots (20) \\ \text{mag}(i) = [\Delta h(i+1) - \Delta k((i+1) \times L) \\ - \Delta h(i) + \Delta k(i \times L)] / L \quad \cdots (21)$$

となる。

【0045】したがって、区間 $i \times L \leq x \leq (i+1)$

$$\Delta h(x) = \Delta k(x) + \text{sft}(i) + \text{mag}(i) \times (x - i \times L) \\ \cdots (22)$$

となる。ただし、 $\text{sft}(i)$ 、 $\text{mag}(i)$ はそれぞれ(20)、(21)式で与えられる。さらに、全区間で $\text{sft}(i)$ と $\text{mag}(i)$ を求めれば、任意の位置における連続的な平面度差 $\Delta h(x)$ を求めることができる。

(15)式によって得られる両長尺鏡の平面度差の暫定式を用いて(3)式によって制御しながら、キャリッジ2を走査する。そしてマスク60上の複数のアライメントマーク62と、プレート61上の複数のアライメントマーク63とのy方向の誤差をアライメント顕微鏡12を用いて計測する。その際、計測終了までは、アライメント顕微鏡12により計測された誤差は補正しない。しかる後、横軸にアライメントマーク62、63の位置を取り、縦軸にy方向の計測誤差をプロットすれば、図7と同様な結果が得られるから、両長尺鏡の離散的な平面度差 $\Delta h(i)$ を求めることができる。

【0042】次に第5工程として、両長尺鏡の離散的な平面度差 $\Delta h(i)$ と、干渉計で計測した各長尺鏡7、8自体の鏡面形状とを合成することにより、任意の位置における長尺鏡の平面度差 $\Delta h(x)$ を求める。干渉計で計測したマスク側長尺鏡7の平面度を $k_m(x)$ とし、プレート側長尺鏡8の平面度を $k_p(x)$ とすると、干渉計で計測した姿勢における両長尺鏡の平面度差 $\Delta k(x)$ は、 $\Delta k(x) = k_m(x) - k_p(x)$ となる。

【0043】両長尺鏡の離散的な平面度差 $\Delta h(i)$ と、干渉計で計測した姿勢における両長尺鏡の平面度差 $\Delta k(x)$ との合成は、各区間 $[i, i+1]$ ごとに $\Delta k(x)$ を区切り、その区間の両端で $\Delta h(i)$ と $\Delta h(i+1)$ とに一致するように、 $\Delta k(x)$ をy方向に移動し、且つy方向に拡大又は縮小することによって行う。すなわち各区間ごとに $\Delta k(x)$ に加算する移動量を $\text{sft}(i)$ とし、各区間ごとに加算する勾配を $\text{mag}(i)$ とすると、

【0044】 $x = i \times L$ において、

$x \times L$ における長尺鏡の連続的な平面度差 $\Delta h(x)$ は、

【0046】なお、マスクステージ3に固定したコーナキューブ19cと反射鏡21cとの間隔L、ないしはプレートステージ4に固定したコーナキューブ20cと反射鏡21eとの間隔Lを相当に狭くしたときには、両長

尺鏡7、8自体の形状を連続的に測定せずに、長尺鏡の互いに隣接する離散的な平面度差 $\Delta h(i)$ と $\Delta h(i+1)$ との間を、線形に補間することもできる。また、長尺鏡の大型化によって、長尺鏡の連続的な平面度が分割して計測された場合には、(22)式の区間 $[i \times L \leq x \leq (i+1) \times L]$ で使用される $\Delta k(x)$ 、すなわち $k_m(x)$ と $k_p(x)$ は、同一の計測で得られたものが望ましい。

【0047】

【発明の効果】以上のように、本発明による走査型露光装置及び測定方法によれば、長尺鏡の平面度に依存することなく、高い露光精度を確保することができる。

【図面の簡単な説明】

【図1】本発明による走査型露光装置の一実施例の構成を示す斜視図

【図2】長尺鏡の面精度を連続的に計測するときの配置図

【図3】暫定式によって生じる誤差を計測するために用いるマスクを示す平面図

【図4】誤差計測用マスクに用いるマークを示す拡大図

【図5】誤差計測用マスクのマークが転写されたプレートを示す平面図

【図6】2回の露光によって転写されたマークの像を示す拡大図

【図7】露光誤差分布を示す説明図

【図8】暫定式によって生じる誤差を計測するために用いる別の(a)マスクと(b)プレートを示す平面図

【図9】図1の走査型露光装置を部分的に表わした斜視図である。

【符号の簡単な説明】

1…架台 2…キャリッジ
3…マスクステージ 4…プレートステー

ジ

5…マスク 6…プレート
7…マスク用長尺鏡 8…プレート用長尺鏡

9、10、11…微動機 12、13…アライメント顕微鏡

14a~14e…マスク照明領域 15a~15eプレート露光領域

I_{x1} 、 I_{x2} 、 I_{cx} 、 I_{my} 、 I_{py} 、 I_{ck} …干渉計

16a、17a、18a、19a、20a、21a…ビームスプリッタ

16b~16e、17b~17e、18b~18e…反射鏡

19b、20b、21b~21e…反射鏡

19c、20c…コーナキューブ

19d、19e、20d、20e… $\lambda/4$ 板

25…制御装置

26…記憶装置

30…レーザー光源

31…ビームエキスパンダ

32…レンズ

33…ハーフミラー

34…裏面

35…参照面

36…検出器

40…誤差計測用マスク

41…マーク

42、43…マスク用アライメントマーク

44、45…プレート用アライメントマーク

46、47…プレート用アライメントマーク転写マーク

48…誤差計測用プレート

49…マーク転写マーク

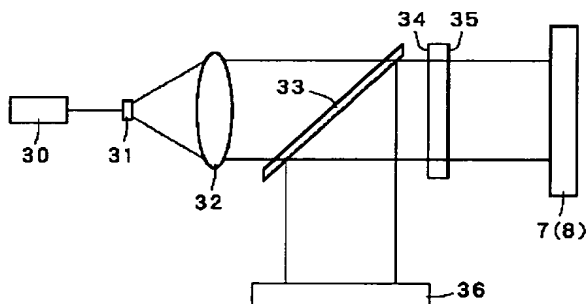
50…回帰直線

60…誤差計測用マスク

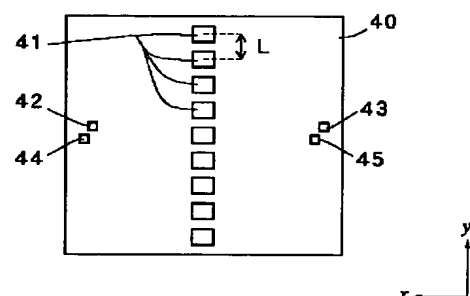
61…誤差計測用プレート

62、63…アライメントマーク

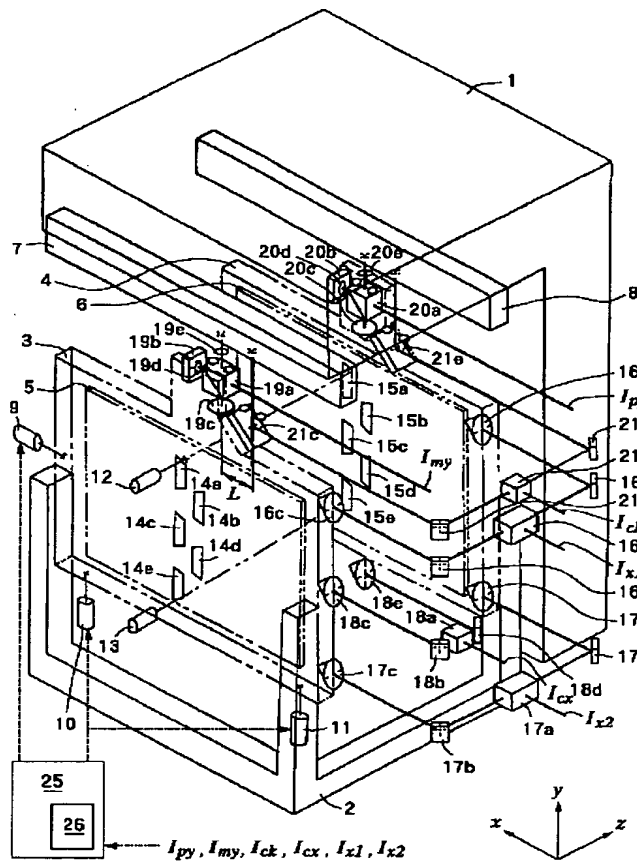
【図2】



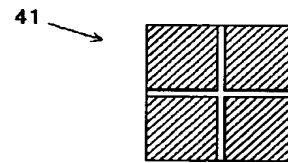
【図3】



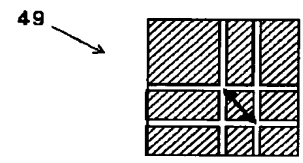
【図 1】



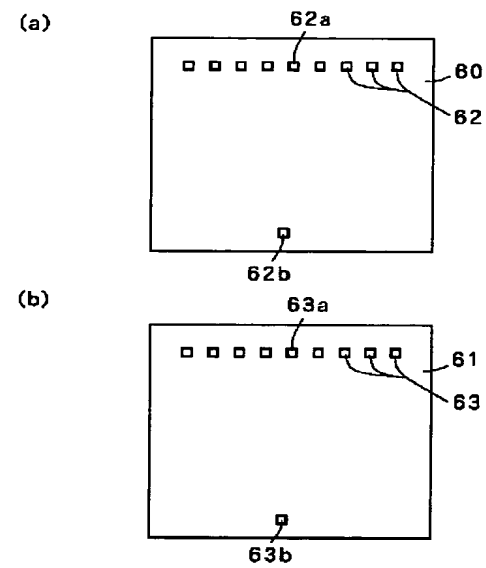
【図 4】



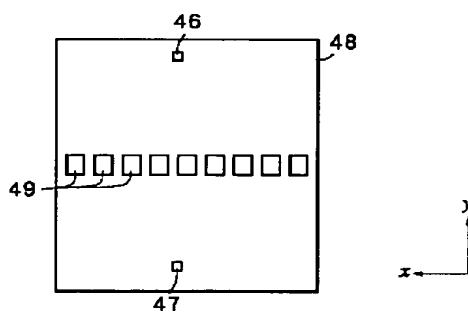
【図 6】



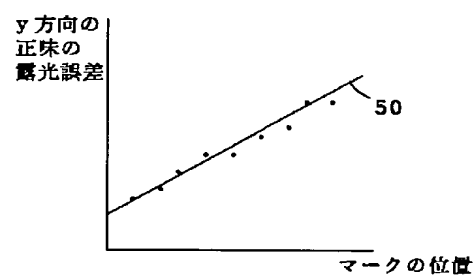
【図 8】



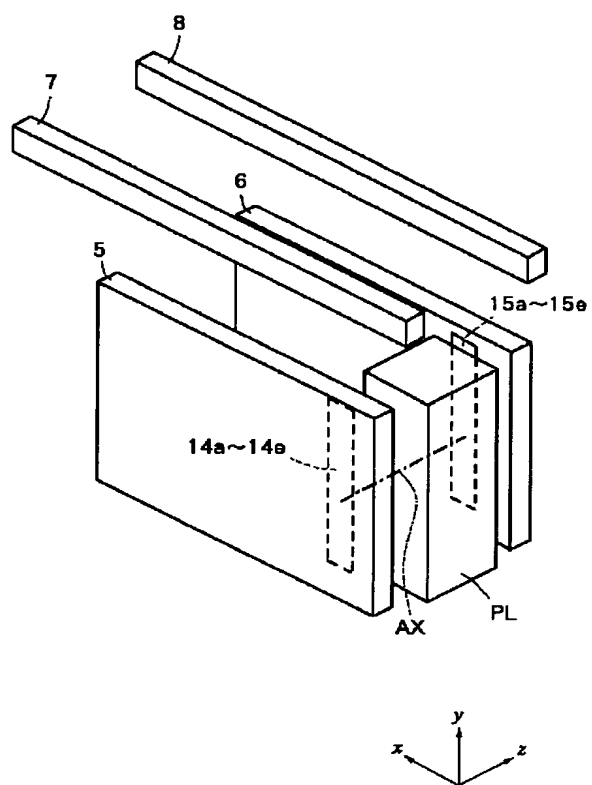
【図 5】



【図 7】



【図 9】



. * NOTICES *

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Begin Translation:

CLAIMS

[Claim(s)]

[Claim 1] The scanned type aligner equipped with the mask which is characterized by providing the following and with which the pattern was formed, the projection optical system which projects the image of the pattern of the aforementioned mask on a sensitization substrate, and the 1st move mechanism in which the aforementioned mask and the aforementioned sensitization substrate are moved in the 1st direction which synchronizes and intersects perpendicularly with the optical axis of the aforementioned projection optical system to the aforementioned projection optical system. The 1st reflecting mirror with the reflector which is fixed along the 1st direction of the above and counters with the predetermined end face of the aforementioned mask. The 2nd reflecting mirror with the reflector which is fixed along the 1st direction of the above and counters with the predetermined end face of the aforementioned sensitization substrate. The 1st interference system which detects the amount about the distance of the predetermined end face of the aforementioned mask, and the 1st reflecting mirror of the above according to the aforementioned movement by the aforementioned 1st move mechanism. A storage means memorize the data about the flatness difference of the aforementioned reflector of the 1st reflecting mirror of the above, and the aforementioned reflector of the 2nd reflecting mirror of the above called for based on the detection result of the 2nd interference system which detects the amount about the distance of the predetermined end face of the aforementioned sensitization substrate, and the 2nd reflecting mirror of the above, and the 1st interference system of the above and the 2nd interference system of the above according to the aforementioned movement by the aforementioned 1st move mechanism.

[Claim 2] The scanned type aligner according to claim 1 characterized by providing the following. The 2nd move mechanism which moves at least one side of the aforementioned mask and the aforementioned sensitization substrate in the direction which intersects perpendicularly in the optical axis and the 1st direction of the above of the aforementioned projection optical system. Control means which control the aforementioned 2nd move mechanism during the aforementioned movement by the aforementioned 1st move mechanism based on the aforementioned data memorized by the aforementioned storage means.

[Claim 3] Data concerning [on a scanned type aligner according to claim 1 and] the aforementioned flatness difference are a scanned type aligner characterized by being complemented with the data about the flatness of the aforementioned reflector of the 1st reflecting mirror of the above before [above] fixation is carried out, and the aforementioned reflector of the 2nd reflecting mirror of the above.

[Claim 4] The scanned type exposure method which is made to move the aforementioned mask and the aforementioned sensitization substrate in the 1st direction which synchronizes and intersects perpendicularly with the optical axis of the aforementioned projection optical system to the aforementioned projection optical system, and exposes the image of the pattern of the aforementioned mask while projecting the image of the pattern of a mask characterized by providing the following on a sensitization substrate by the projection optical system. The 1st reflecting mirror which has the predetermined end face of the aforementioned mask, and the reflector which counters, and was fixed along the 1st direction of the above. The 1st step which detects dispersedly the amount about distance with the predetermined end face of the aforementioned mask according to the aforementioned movement. The 2nd reflecting mirror which has the predetermined end face of the aforementioned sensitization substrate, and the reflector which counters, and was fixed along the 1st direction of the above. The 2nd step which detects dispersedly the amount about distance with the predetermined end face of the aforementioned sensitization substrate according to the aforementioned movement, and the step which asks for the data about the flatness difference of the aforementioned reflector of the 1st reflecting mirror of the above, and the aforementioned reflector of the 2nd reflecting mirror of the above based on the above 1st and the detection result of the 2nd step.

[Claim 5] The step which asks for the data about the aforementioned flatness difference in the scanned type exposure method according to claim 4 is the scanned type exposure method characterized by asking based on the data about the flatness of the aforementioned reflector of the 1st reflecting mirror of the above before [above] fixation is carried out, and the aforementioned reflector of the 2nd reflecting mirror of the above.

[Claim 6] The scanned type exposure method characterized by including the step which moves at least one side of the aforementioned mask and the aforementioned sensitization substrate in the direction which intersects perpendicularly in the optical axis and the 1st direction of the above of the aforementioned projection optical system according to the data about the aforementioned flatness difference in the scanned type exposure method according to claim 4 or 5 during the aforementioned exposure.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to a scanned type aligner, and relates to amendment of the position gap with the mask stage and plate stage especially in the middle of a scanning.

[0002]

[Problem(s) to be Solved by the Invention] The technology which carries out scanning exposure is indicated without making severe profile irregularity of the long mirror used as the criteria for measuring the relative position gap between the masks about a longitudinal

direction and plates which intersect perpendicularly with the both sides of the normal of a mask, and a scanning direction to Japanese Patent Application No. No. 184113 [eight to] prolonged in the scanning direction, since it corresponds to enlargement of the latest liquid crystal substrate. however, in this technology, when the wave of a short period is in a long mirror, it is kept highly precise on the level which can disregard the strike slip between a mask and a plate -- there was un-arranging [that things did not have the result] this invention makes it a technical problem to offer the scanned type aligner which can carry out scanning exposure with high precision, and its technique in view of this trouble, without being based on the profile irregularity of a long mirror.

[0003]

[Means for Solving the Problem] If it matches and explains to drawing 1 which is made in order that this invention may solve the above-mentioned technical problem, and expresses one example The mask (5) with which the pattern was formed, and the projection optical system which projects the image of the pattern of the aforementioned mask on a sensitization substrate (6), In the scanned type aligner equipped with the 1st move mechanism in which the aforementioned mask and the aforementioned sensitization substrate are moved in the 1st direction which synchronizes and intersects perpendicularly with the optical axis of the aforementioned projection optical system to the aforementioned projection optical system The 1st reflecting mirror with the reflector which is fixed along the 1st direction of the above and counters with the predetermined end face of the aforementioned mask (7), The 2nd reflecting mirror with the reflector which is fixed along the 1st direction of the above and counters with the predetermined end face of the aforementioned sensitization substrate (8), The 1st interference system which detects the amount about the distance of the predetermined end face of the aforementioned mask, and the 1st reflecting mirror of the above according to the aforementioned movement by the aforementioned 1st move mechanism (1my, 1ck, 1x1, 1x2), The 2nd interference system (1py, 1ck, 1x1, 1x2) which detects the amount about the distance of the predetermined end face of the aforementioned sensitization substrate, and the 2nd reflecting mirror of the above according to the aforementioned movement by the aforementioned 1st move mechanism, It is the scanned type aligner characterized by establishing a storage means (26) to memorize the data about the flatness difference of the aforementioned reflector of the 1st reflecting mirror of the above, and the aforementioned reflector of the 2nd reflecting mirror of the above called for based on the detection result of the 1st interference system of the above, and the 2nd interference system of the above.

[0004] While this invention projects the image of the pattern of a mask (5) on a sensitization substrate (6) by the projection optical system, again In the scanned type exposure method which is made to move the aforementioned mask and the aforementioned sensitization substrate in the 1st direction which synchronizes and intersects perpendicularly with the optical axis of the aforementioned projection optical system to the aforementioned projection optical system, and exposes the image of the pattern of the aforementioned mask The 1st reflecting mirror which has the predetermined end face of the aforementioned mask, and the reflector which counters, and was fixed along the 1st direction of the above (7), The 1st step which detects the amount about distance with the predetermined end face of the aforementioned mask according to the aforementioned movement, The 2nd reflecting mirror which has the predetermined end face of the aforementioned sensitization substrate, and the reflector which counters, and was fixed along the 1st direction of the above (8), The 2nd step which detects the amount about distance with the predetermined end face of the aforementioned sensitization substrate according to the aforementioned movement, It is the scanned type exposure method characterized by including the step which asks for the data about the flatness difference of

the aforementioned reflector of the 1st reflecting mirror of the above, and the aforementioned reflector of the 2nd reflecting mirror of the above based on the above 1st and the detection result of the 2nd step.

[0005]

[Embodiments of the Invention] The form of operation of this invention is explained using a drawing. The outline composition of one example of the scanned type aligner by this invention is shown in drawing 1. In the following explanation, the system of coordinates which make a scanning direction, i.e., lengthwise, a x axis, make the y-axis the longitudinal direction which intersects perpendicularly in the same field as a mask 5 in a x axis, and make the direction of a normal of a mask 5 the z-axis are taken. The lighting light injected from the light sources (un-illustrating), such as an extra-high pressure mercury lamp, is led to 5 lighting optical system (un-illustrating) through an optical fiber (un-illustrating) etc. Each lighting optical system is constituted including a fly eye lens, a field diaphragm (un-illustrating), etc., respectively. Each lighting light injected from each lighting optical system illuminates uniformly the lighting fields 14a-14e where it differs on a mask 5. Each flux of light which passed the mask 5 exposes the exposure fields 15a-15e where it differs on the plate 6 which is a sensitization substrate through the projection optical system PL with the five projection lens sections which perform image formation of actual size erection, respectively (refer to drawing 9), and carries out image formation of the image of the pattern of the lighting fields 14a-14e on a mask 5 on a plate 6 in this way. Although each lighting fields 14a-14e are separated, respectively and it is arranged, the addition width of face which integrated the width of face of the x directions of each lighting fields 14a-14e in the x directions is formed so that it may continue in the direction of y with the same width of face.

[0006] Each lighting optical system and each projection optical system are supported with the stand 1. The carriage 2 by which a run drive is carried out is carried in the x directions by the driving gear (un-illustrating) at the stand 1, and the mask stage 3 and the plate stage 4 are held at this carriage 2. The mask 5 is held at the mask stage 3, the plate 6 is held on the plate stage 4, and the whole pattern on a mask 5 is imprinted on a plate 6 by scanning carriage 2 in the x directions in this way. The mask stage 3 is constituted so that it may be supported by carriage 2 through the jogging machines 9-11, namely, the position of the x directions of a mask stage 3 may be moved slightly with the x direction jogging machine 9 and the position of the direction of y of a mask stage 3 and the hand of cut of the circumference of the z-axis can be moved slightly with the direction jogging machines 10 and 11 of y.

[0007] On the other hand, in order to amend the influence of the thickness nonuniformity of a plate 6, or an inclination and to make it simultaneously in agreement with the image formation side of a mask pattern, the plate stage 4 is supported by carriage 2 through the three or more direction jogging machines (un-illustrating) of z, and it is constituted so that jogging (auto-focusing) of the direction of z and the degree of tilt angle of the circumference of a x axis and the circumference of the y-axis (auto leveling) can be adjusted in this way. Moreover, the long mirror 7 for masks and the long mirror 8 for plates are being fixed to the stand 1. Both the long picture mirrors 7 and 8 are reflecting mirrors prolonged for a long time in the x directions, and the normal of the reflector has turned to the direction of y. The long mirror 7 for masks counters a mask stage 3, and is arranged, and the long mirror 8 for plates counters the plate stage 4, and is arranged.

[0008] Drawing 9 is the perspective diagram which expressed the scanned type aligner of drawing 1 partially. The projection optical system PL has the five projection lens sections arranged alternately in order to project the flux of light which passed through each field of the lighting fields 14a-14e on a plate 6. In addition, on behalf of the five projection lens

sections, it expresses with drawing 9 the projection optical system PL, and the optical axis of a projection optical system PL is indicated to be AX. It is arranged along the direction of X the long mirror 7 for masks and whose long mirror 8 for plates are the 1st direction which intersects perpendicularly with the optical axis AX of a projection optical system PL so that clearly from drawing 9 .

[0009] It returns to drawing 1 and the position and posture of a mask stage 3 and the plate stage 4 are supervised as follows by six interferometers Ix1, Ix2, Icx, Imy, Ipy, and Ick. The differential type interferometer Ix1 is first for measuring a relative position gap (vertical gap) of the x directions of a mask stage 3 and the plate stage 4. Namely, the laser beam bunch injected from the laser light source (un-illustrating) fixed to the stand 1 It is divided by beam-splitter 16a fixed to the stand 1, and each divided flux of light Reflect with the reflecting mirrors 16b and 16d fixed to the stand 1, respectively, and it is fixed to a mask stage 3 and the plate stage 4, respectively, and reflects with reflecting mirrors 16c and 16e. It reverses, is compounded by beam-splitter 16a, and interferes in an outward trip, and incidence is carried out to the receiver (un-illustrating) of an interferometer Ix1.

[0010] An interferometer Ix1 is for measuring a relative position gap (vertical gap) of the x directions of a mask stage 3 and the plate stage 4 in the position where the differential type interferometers Ix2 differ in the direction of y. That is, the laser beam bunch for interferometer Ix2 is divided by beam-splitter 17a, and it reflects with reflecting mirrors 17b and 17d, respectively, is fixed to a mask stage 3 and the plate stage 4, respectively, and reflects with reflecting mirrors 17c and 17e, and each divided flux of light reverses, is compounded by beam-splitter 17a, and carries out incidence of the outward trip to the receiver of an interferometer Ix2. In addition, an interval with the reflecting mirrors 16c and 17c fixed to the mask stage 3 and the interval with the reflecting mirrors 16e and 17e fixed to the plate stage 4 are equal, and set this interval to H henceforth. As for the position of the reflecting mirrors 16c and 17c on a mask stage 3, and the reflecting mirrors 16e and 17e on the plate stage 4, it is desirable that it is in the equal distance from the center of each stages 3 and 4.

[0011] The measured type interferometer Icx of the length is for measuring the travel of carriage 2. The laser beam bunch for Interferometers Icx is divided by beam-splitter 18a, and namely, each divided flux of light Reflect with the reflecting mirrors 18b and 18d fixed to the stand 1, respectively, and one flux of light is reflected by reflecting mirror 18c fixed on the mask stage 3. Reflecting the flux of light of another side by fixed mirror 18e fixed to the projection optical system, it reverses, is compounded by beam-splitter 18a, and interferes in an outward trip, and both the flux of lights carry out incidence to the receiver of Interferometer Icx. In this way, by Interferometer Icx, the distance of the x directions of a mask stage 3 and fixed mirror 18e is measured.

[0012] The measured type interferometer Imy of the length is for measuring the distance of the direction of y of a mask stage 3 and the long mirror 7 for masks. Moreover, the measured type interferometer Ipy of the length is for measuring the distance of the direction of y of the plate stage 4 and the long mirror 8 for plates. Since both the interferometers Imy and Ipy are the same composition, the explanation about Interferometer Imy is indicated out of a parenthesis, and the explanation about Interferometer Ipy is indicated in a parenthesis. That is, the laser beam bunch for interference systems Imy (Ipy) is divided into the two flux of lights by beam-splitter 19a (20a) fixed to the mask stage 3 (plate stage 4). this -- two -- a ** -- the flux of light -- inside -- a beam splitter -- 19 -- a (20a) -- having penetrated -- the flux of light -- a mask stage -- three (plate stage 4) -- a top -- arranging -- having had -- λ -- four -- a board -- 19 -- d (20d) -- a passage -- a mask stage -- three (plate stage 4) -- a top -- arranging -- having had -- a reflecting mirror -- 19 -- b (20b) -- reflecting -- again -- The flux of light which passed along 19d (20d) of $\lambda/4$ boards Beam-splitter

19a (20a), Cube-corner-reflector 19c arranged on the mask stage 3 (plate stage 4) (20c), beam-splitter 19a (20a) -- respectively -- reflecting -- 19d (20d) of lambda/4 boards -- a passage -- reflecting mirror 19b (20b) -- reflecting -- 19d (20d) of lambda/4 boards, and beam-splitter 19a (20a) -- respectively -- a passage -- an interference system I_{my} (I_{py}) -- incidence is carried out to a receiver

[0013] the flux of light reflected up by beam-splitter 19a (20a) of the flux of lights divided by beam-splitter 19a (20a) -- lambda / 4 board 19e (20e) -- a passage -- the long mirror 7 (8) -- reflecting -- lambda / 4 board 19e (20e), and beam-splitter 19a (20a) -- respectively -- a passage -- cube-corner-reflector 19c (20c) -- reflecting . the flux of light reflected by cube-corner-reflector 19c (20c) -- beam-splitter 19a (20a), and lambda/4 board 19e (20e) -- respectively -- a passage -- the long mirror 7 (8) -- reflecting -- lambda / 4 board 19e (20e) - - a passage -- beam-splitter 19a (20a) -- reflecting -- having -- an interference system I_{my} (I_{py}) -- incidence is carried out to a receiver Thereby, the flux of light divided into the two flux of lights by beam-splitter 19a (20a) is again compounded by beam-splitter 19a (20a), and it interferes in it, and it carries out incidence to a receiver.

[0014] The differential type interferometer I_{ck} is for measuring a relative position gap of the direction of y of a mask stage 3 and the plate stage 4 through both the long picture mirrors 7 and 8. That is, the laser beam bunch for Interferometers I_{ck} is divided by beam-splitter 21a, each divided flux of light is reflected with the reflecting mirrors 21b and 21d fixed to the stand 1, respectively, it reflects by reflecting mirror 21c on a mask stage 3, and one flux of light is reflected in the long mirror 7 for masks. It reflects by reflecting mirror 21e on the plate stage 4, and the flux of light of another side is reflected in the long mirror 8 for plates. Both the flux of lights reverse, are compounded by beam-splitter 21a, interfere in an outward trip, and carry out incidence to the receiver of Interferometer I_{ck} . In addition, the interval of the x directions of cube-corner-reflector 20c and reflecting mirror 21e which were fixed to the interval and the plate stage 4 of the x directions of cube-corner-reflector 19c and reflecting mirror 21c which were fixed to the mask stage 3 is equal, and sets this interval to L henceforth.

[0015] The position of carriage 2 is set to x, the relative amount of position gaps of the x directions of a mask stage 3 and the plate stage 4 (the amount of vertical gaps) is set to $\Delta X(x)$, the relative amount of position gaps of the direction of y (the amount of strike slips) is set to $\Delta Y(x)$, and the relative amount of angle gaps of the circumference of the z-axis is set to $\Delta T(x)$. Moreover, the flatness difference of both the long picture mirrors 7 and 8 is set to $\Delta h(x)$. Flatness difference Δh is the relative amount of position gaps of the direction of y of the reflector of the long mirror 7 for masks, and the reflector of the long mirror 8 for plates (the amount of strike slips). When the measurement value of each interferometers I_{x1} , I_{x2} , I_{cx} , I_{my} , I_{py} , and I_{ck} is expressed as I_{x1} , I_{x2} , I_{cx} , I_{my} , I_{py} , and I_{ck} using the respectively same character, it is $\Delta X(x) = (I_{x1} + I_{x2})/2$ (1)

$\Delta T(x) = (I_{x1} - I_{x2})/H$ (2)

$\Delta Y(x) = I_{my} - I_{py} - \Delta h(x)$ (3)

It becomes.

[0016] The value of angle gap ΔT of vertical gap ΔX of (1) formula and (2) formulas is immediately acquired from the measurement value of interferometers I_{x1} and I_{x2} among the above-mentioned (1) - (3) formulas. Moreover, about strike slip ΔY of (3) formulas, flatness difference Δh is stored in the storage 26 in a control unit 25 as a function of the position x of carriage 2, and strike slip ΔY is calculated from this $\Delta h(x)$ and measurement value of Interferometers I_{my} and I_{py} . In this way, the relative physical relationship of the mask stage 3 at the time of scanning exposure and the plate stage 4 is kept constant by driving the jogging machines 9-11 and tuning the position of a mask stage 3 finely in a x-y side with a control unit 25, to vertical gap ΔX in a x-y side, strike slip

ΔY , and angle gap ΔT .

[0017] How to ask below for flatness difference $\Delta h(x)$ of both the long picture mirrors 7 and 8 is explained. This flatness difference $\Delta h(x)$ is dependent on the installation posture to the mirror-plane configuration of each long mirror 7 and 8 the very thing, and the stand 1 of each long mirrors 7 and 8. This example measures continuously the mirror-plane configuration of each long mirror 7 and 8 the very thing in one side. By measuring dispersedly flatness difference $\Delta h(x)$ when attaching each long mirrors 7 and 8 in a stand 1 in another side $\Delta h(x)$, and interpolating the inside of each section of flatness difference Δh for which after an appropriate time was asked dispersedly with the difference of the continuous configuration of both the long picture mirrors 7 and 8. It asks for flatness difference Δh as a continuous function of x .

[0018] Then, how to search for continuously the mirror-plane configuration of each long mirror 7 and 8 the very thing is explained first. Drawing 2 is drawing having shown the outline for measuring continuously the profile irregularity of each long mirrors 7 and 8. It is efficient to perform this measurement to serve both as a check and measurement of profile irregularity at the time of the polish end of the long mirrors 7 and 8 before the inclusion to a stand 1. Moreover, as for the posture of the long mirrors 7 and 8 at the time of measurement, it is desirable to suppose that it is the same as that of the posture when including in a stand 1.

[0019] The laser beam bunch injected from the laser light source 30 can extend **** with the beam expander 31, and serves as a parallel ray through a lens 32. Subsequently, a laser beam penetrates a one-way mirror 33, it reflects in respect of [35] the reference prepared in the last side of the Fizeau element, and a part of transmitted light reverses an outward trip, and it returns to a one-way mirror 33. The rear face 34 of the reference side 35 is coated with the antireflection film. On the other hand, it reflects in the long mirror 7 (or long mirror 8 for plates) for masks, and the laser beam which penetrated the reference side 35 reverses an outward trip, and returns to a one-way mirror 33. It interferes, and reflects by the one-way mirror 33, and the laser beam reflected in respect of [35] reference and the laser beam reflected in the long mirror 7 (8) reach a detector 36. In this way, it becomes possible to be able to measure the profile irregularity of the long mirror 7 (8) to the reference side 35 with a detector 36, namely, to ask for the flatness in the arbitrary points of the long mirror 7 (8).

[0020] In addition, although, as for the long mirror 7 (8), a bird clapper is expected for a long time with enlargement of a liquid crystal substrate, when it becomes longer than the reference side 35, the whole surface can be measured by shifting the long mirror 7 (8) and measuring multiple times. However, it is necessary to make the measure point by the interferometers I_{my} , I_{py} , and I_{ck} later mentioned in this case overlap, and to measure. Moreover, although the Fizeau interferometer was used for measurement of the profile irregularity of the long mirror 7 (8) in drawing 2, the measurement method was not restricted to this.

[0021] Next, how to measure the flatness difference of a long mirror dispersedly is explained. Measurement is measured at every fixed measurement interval L , scanning carriage 2. A measurement end fixes a mask stage 3 and the plate stage 4 relatively, namely, the jogging machines 9-11 do not drive it. Let the interval L which measures be the interval of the x directions of the position which the flux of light of Interferometer I_{my} or Interferometer I_{py} reflects in the long mirror 7 or the long mirror 8, and the position which the flux of light of Interferometer I_{ck} reflects in the long mirror 7 or the long mirror 8. Measurement is performed as follows. The value of the interferometers I_{my} , I_{py} , and I_{ck} when moving carriage 2 to the end of the long mirrors 7 and 8 is measured. Subsequently, measuring the position of carriage 2 with Interferometer I_{cx} , only L moves the position of

carriage 2 and the value of Interferometers I_{my} , I_{py} , and I_{ck} is measured in the position. Like the following, whenever only L moves the position of carriage 2, the value of Interferometers I_{my} , I_{py} , and I_{ck} is measured.

[0022] Below, since it is easy, the measurement value of the interferometers I_{my} , I_{py} , and I_{ck} in the dispersed measurement position i on a long mirror is marked as $I_{my}(i)$, $I_{py}(i)$, and $I_{ck}(i)$, respectively. That is, when a dispersed position is meant, Variable i is used, and Variable x is used when a continuous position is meant. In addition, in the position of the same carriage 2, $I_{my}(i)$, $I_{py}(i)$, and $I_{ck}(i-1)$ are measured clearly. Moreover, the value of the interferometer in a measurement starting position is set to $I_{my}(1)$, $I_{py}(1)$, and $I_{ck}(0)$.

[0023] Interferometer I_{my} is measuring the distance of the direction of y of a mask stage 3 and the long mirror 7 for masks, and Interferometer I_{py} is measuring the distance of the direction of y of the plate stage 4 and the long mirror 8 for plates. Therefore, the rolling error (rotation of the circumference of a x axis) of carriage 2 and the offset at the time of interferometer reset are included in the measurement value of both these interferometers I_{my} and I_{py} in addition to flatness difference δ_{tah} of both the long picture mirrors 7 and 8. The flatness difference of both the long picture mirror in the measurement position i is set to $\delta_{tah}(i)$, the amount of rolling is set to $r(i)$, and the offset at the time of reset of both the interferometers I_{my} and I_{py} is set to A and B , respectively.

[0024] It is newly $I_y(i) = I_{my}(i) - I_{py}$ about $I_y(i)$ as a difference of the measurement value of both the interferometers I_{my} and I_{py} (4)

A definition materializes the following formula.

$$I_y(i) = I_{my}(i) - I_{py}(i) \\ = \delta_{tah}(i) + r(i) + A - B \dots (5)$$

(5) Among a formula, $I_y(i)$ is measured value and the right-hand side's is strange.

[0025] Moreover, Interferometer I_{ck} is measuring the position gap of the direction of y of a mask stage 3 and the plate stage 4 through both the long picture mirrors 7 and 8. Therefore, the position gap resulting from vertical gap δ_{taX} of a mask stage 3 and the plate stage 4 and angle gap δ_{taT} of the circumference of the z -axis other than the offset C at the time of the error r resulting from flatness difference δ_{tah} of both the long picture mirrors 7 and 8 and rolling of carriage 2 and interferometer reset is further included in the measurement value of Interferometer I_{ck} . Moreover, the amount of rolling contained in the measurement value of the interferometers I_{my} , I_{py} , and I_{ck} measured simultaneously is equal. Therefore, $I_{ck}(i-1)$ is expressed with the following formula.

$$I_{ck}(i-1) = \delta_{tah}(i-1) + r(i) + C + \delta_{taX}(i-1) + \delta_{taT}(i-1) - H \dots (6)$$

[0026] Since vertical gap δ_{taX} and angle gap δ_{taT} are measured value, if they define I_{ck}' by (7) formulas, (6) formulas will turn into (8) formulas.

$$I_{ck}'(i) = I_{ck}(i) - \delta_{taX}(i) - \delta_{taT}(i) - H \dots (7)$$

$$I_{ck}'(i-1) = \delta_{tah}(i-1) + r(i) + C \dots (8)$$

(8) Among a formula, $I_{ck}'(i-1)$ is measured value, and the right-hand side's is strange.

[0027] Furthermore, if (9) formulas define δ_{taH} in order to eliminate the error r resulting from rolling of carriage 2, δ_{taH} will become like (5) formulas and (8) formulas to (10) formulas.

$$\delta_{taH}(i) = I_y(i) - I_{ck}'(i-1) \dots (9)$$

$$\delta_{taH}(i) = \delta_{tah}(i) - \delta_{tah}(i-1) + A - B - C \dots (10)$$

(10) Among a formula, $\delta_{taH}(i)$ is calculated from the measurement value of interferometers I_{my} , I_{py} , I_{ck} , I_{x1} , and I_{x2} , and the right-hand side's is strange.

[0028] If the sum from $i=1$ to $i=k$ ($k \geq 1$) of $\delta_{taH}(i)$ is set to $S(k)$ and the position k of a long mirror is newly marked as a position i $S(i) = \delta_{taH}(1) + \delta_{taH}(2) + \dots + \delta_{taH}(i)$

$$S(i) = \delta_{tah}(1) - \delta_{tah}(0) + A - B - C + \delta_{tah}(2) - \delta_{tah}(1) + A - B - C + \dots + \delta_{tah}(i) - \delta_{tah}(i-1)$$

$$1)+A-B-C = \text{deltah}(i) - \text{deltah}(0) + (A-B-C) \cdot x_i \quad (i \geq 1)$$

.... (11b)

It becomes. (11b) Among a formula, $S(i)$ is measured value and the right-hand side's is strange. flatness difference $\text{delta}[$ of a long mirror / in / a position i / in this way (11b) / from a formula $]/h(i) \text{ delta} \rightarrow h(i) = S(i) + \text{deltah}(0) - (A-B-C) \cdot x_i \quad (i \geq 1)$

.... (12)

It becomes. If it sets with $S(0) \neq 0$ at the time of $i = 0$, (12) formulas will be realized also at the time of $i = 0$.

[0029] (12) Among the right-hand side of a formula, $S(i)$ is measured value and $\text{deltah}(0)$ and $x(A-B-C) \cdot i$ are unknowns. Among these, since $\text{deltah}(0)$ is always fixed offset irrespective of the measurement position i of a long mirror, it does not become an error by amount of strike slips $\text{delta}[$ between a mask stage 3 and the plate stage 4] Y's (x)'s not changing, namely, carrying out alignment of a mask stage 3 and the plate stage 4 so that more clearly than (3) formulas. On the other hand, since $x(A-B-C) \cdot i$ changes to alignment depending on the position i of a long mirror, it needs to ask for the coefficient $(A-B-C)$. Then, how to ask for a coefficient $(A-B-C)$ next is shown.

[0030] First, as the 1st process, in order to measure S in (12) formulas (i), carriage 2 is scanned and the measurement value of each interferometer is measured. At this time, amount of vertical gaps $\text{delta}X$ between a mask stage 3 and the plate stage 4 is continuously measured by (1) formula like previous statement, and amount of angle gaps $\text{delta}T$ in a x-y side can scan carriage 2, keeping constant these amounts $\text{delta}X$ and $\text{delta}T$ of gaps, since it is continuously measured by (2) formulas. However, flatness difference $\text{deltah}(x)$ is not only strange, but since discrete-value $\text{deltah}(i)$ is strange, amount of strike slips $\text{delta}Y$ cannot keep amount of strike slips $\text{delta}Y$ constant. Then, first, carriage 2 is scanned without performing adjustment of a strike slip at all, and $x = 0$ at that time, $L, 2xL, \dots, ixL$, the measurement value I_{my} of Interferometers I_{my} and I_{py} in .. (i), and $I_{py}(i)$ are measured. Subsequently, as the 2nd process, it asks for $S(i)$ by the formula (11a).

[0031] Subsequently, as the 3rd process, in order to calculate $(A-B-C)$ in (12) formulas, the mask 40 for error measurement shown in drawing 3 is set to a mask stage 3, the plate for error measurement is set to the plate stage 4, and 1st scanning exposure is performed. However, although S in (12) formulas (i) became known, since the coefficient $(A-B-C)$ is strange, it disregards this coefficient $(A-B-C)$, namely, it is $\text{deltah}(i) = S$ as a provisional formula of the flatness difference of both the long picture mirror (i). (13)

*****. Moreover, since i is a discrete value, it interpolates between $\text{deltah}(i)$ and $\text{deltah}(i+1)$ by the primary formula. That is, the relation between the measurement position i and the position x of the carriage 2 measured with Interferometer I_{cx} is expressed with the following formula when the value of the interferometer I_{cx} in a measurement starting position is set to 0.

$$x = ixL \quad \dots (14)$$

[0032] Therefore, provisional formula $\text{delta}[$ of the flatness difference of both the long picture mirror in case carriage 2 is between the measurement position i on a long mirror and $i+1$] $h(x)$ is expressed with the following formula.

$$\text{deltah}(x) = [\text{deltah}(i+1) - \text{deltah}(i)] \cdot x \cdot (x/L - i) + \text{deltah}(i) \quad \dots (15)$$

Carriage 2 is scanned asking for amount of strike slips $\text{delta}Y$ between a mask stage 3 and the plate stage 4, and keeping constant this amount of strike slips $\text{delta}Y$ by (3) formulas, since the estimate of the flatness difference of both the long picture mirror is continuously obtained by (13) formulas and (15) formulas in this way.

[0033] Drawing 3 shows the mask 40 for error measurement, and two or more marks 41 are drawn by this mask 40 in the x directions at one train, and are drawn in the direction of y

again at every interval L. As for the interval of the direction of y of a mark 41, it is desirable to make it in agreement with the measurement interval L in dispersed flatness measurement of both the long picture mirror. Drawing 4 shows the enlarged view of one mark 41, and is a pattern for exposure position detection. In this drawing, the slash section is a shading field and a cross-like portion is a light transmission field. Although the cross hair was used for exposure position detection here, what mark may be used as long as it is the mark which can detect an exposure position. Moreover, the alignment marks 42 and 43 for masks of a couple and the alignment marks 44 and 45 for plates of a couple are drawn by the mask 40 for error detection. both the marks 42 and 43; -- it shifts a little to the both sides of x directions and the direction of y, and 44 and 45 are arranged to them, as shown in drawing 3

[0034] A plate is developed after scanning exposure of a mask 40. As shown in a plate 48 at drawing 5, the imprint mark (un-illustrating) of the alignment marks 42 and 43 for masks and the imprint marks 46 and 47 of the alignment marks 44 and 45 for plates other than the imprint mark 49 of two or more marks 41 are imprinted. Subsequently, both a mask 40 and a plate are rotated 90 degrees, it sets to a mask stage 3 and the plate stage 4, respectively, and alignment of the alignment marks 42 and 43 for masks on a mask 40 and the alignment mark imprint marks 46 and 47 for plates on a plate 48 is performed. namely, both the marks 42 and 43; -- the relative position error of 46 and 47 -- the alignment microscopes 12 and 13 -- measuring -- the mark motives 9-11 -- driving -- both the marks 42 and 43; -- the position of 46 and 47 is doubled and 2nd exposure is performed after an appropriate time

[0035] It shifts in the alignment marks 42 and 43 for masks on a mask 40, the alignment marks 44 and 45x for plates, and the direction of y a little, and is arranged, and alignment of the alignment marks 42 and 43 for masks and the imprint mark of the alignment mark for plates was carried out at the time of the 2nd exposure. Therefore, between the 1st exposure and the 2nd exposure, it means that only the interval of the alignment marks 42 and 43 for masks and the alignment marks 44 and 45 for plates had shifted and exposed the mask 40 and the plate 48.

[0036] Consequently, the image 49 of two or more marks 41 obtained by two exposure turns into an image with two cross hairs, as shown in drawing 6. The amount of gaps of the net between both cross hairs can be known by measuring the interval of both cross hairs under a microscope etc., and deducting the amount of position gaps of a mask 40 and a plate 48 from this measured value. Control of the jogging machines 9-11 is correctly controlled in the x directions, and is controlled by the provisional formula in the direction of y here. Therefore, between a mark 41 and its image, there is no gap in the x directions and only the error by having controlled by the provisional formula produces a position gap in the direction of y. Namely, in the 1st exposure, since there is no gap between a mark 41 and its image in the x directions and it was rotating 90 degrees at the time of the 2nd exposure, speaking of the arrangement at the time of the 2nd exposure, there is no gap between a mark 41 and its 1st image in the direction of y. Moreover, between a mark 41 and its 2nd image, only the error by having controlled by the provisional formula in the direction of y produces a position gap about the arrangement at the time of the 2nd exposure. Therefore, by measuring the amount of gaps of the net of the direction of y between both cross hairs, the error by having controlled by the provisional formula can be known.

[0037] Subsequently, it asks for a coefficient (A-B-C) as the 4th process. Drawing 7 is drawing which took the position i of a mark 41 along the horizontal axis, and plotted the amount of position gaps of the net of the direction of y, i.e., a longitudinal direction, on the vertical axis. The amount of position gaps of lateral net is $-\Delta(0) + (A-B-C) \cdot x_i \dots (16)$

Since it becomes, if it asks for a regression line 50 from the point which drawing 7 plotted, the inclination will serve as a coefficient (A-B-C). It can ask for dispersed flatness difference Δh (i) of both the long picture mirror from (12) formulas in this way.

[0038] In addition, in each measure point where control of the jogging machine in the 3rd process measured S (i), the right control is performed except for the point that x(A-B-C) i is disregarded. Therefore, as for the measure point which measures the net amount of strike slips, it is desirable to make it in agreement with the measure point when asking for S (i). It is because there is a possibility that elements other than x(A-B-C) i may be added when the net amount of strike slips is measured points other than the measure point when asking for S (i). In order to make in agreement the measure point which measures the net amount of strike slips, and the measure point when asking for S (i), it is necessary to make the interval of a mark 41 first in agreement with the measurement interval L when asking for S (i). Subsequently, what is necessary is to set a mask 40 by arrangement of the 2nd exposure, and just to let the place which moved carriage by the integral multiple of L be a criteria position from the place whose mark 41 on a mask 40 corresponds with an exposure position, in case you decide the criteria position of the scanning direction of carriage 2, in order to make the measure point itself in agreement. In addition, naturally you may reverse the sequence of the 1st exposure and the 2nd exposure.

[0039] Moreover, when the measure point which measures the net amount of strike slips in this way, and the measure point when asking for S (i) are made in agreement, especially control of the jogging machine in the mid-position of each measure point does not pose a problem. Therefore, although between each measure point was only interpolated to alignment in this example, between each measure point can also be interpolated according to the actual flatness difference of both the long picture mirror, for example. Thus, the technique of interpolating between each measure point according to the actual flatness difference of both the long picture mirror is effective when it is difficult to make in agreement the measure point which measures the net amount of strike slips, and the measure point when asking for S (i).

[0040] Moreover, by two exposure, it can replace with the method of measuring a position gap of the direction of y dispersedly, and a position gap of the direction of y can also be measured dispersedly as follows, without exposing. That is, as it is indicated in (b) as drawing 8 (a), to the mask [for error measurement] 60, and end side of the direction of y of a plate 61, two or more alignment marks 62 and alignment marks 63 are arranged in the x directions at intervals of L, respectively, and alignment mark 62b and alignment mark 63b are arranged at the other end side of the direction of y, respectively. Positioning of a mask 60 and a plate 61 is performed by setting this mask 60 and plate 61 to a mask stage and a plate stage, respectively, carrying out alignment of one alignment mark 62a of two or more alignment marks 62 on a mask 60, and the one alignment mark 63a of two or more alignment marks 63 on a plate 61, and carrying out alignment of alignment mark 62b on a mask 60, and the alignment mark 63b on a plate 61.

[0041] Subsequently, amount of vertical gaps ΔX is correctly controlled by (1) formula, amount of angle gaps ΔT in a x-y side is correctly controlled by (2) formulas, and amount of strike slips ΔY scans carriage 2, controlling by (3) formulas using the provisional formula of the flatness difference of both the long picture mirror obtained by (13) formulas and (15) formulas. And the error of the direction of y of two or more alignment marks 62 on a mask 60 and two or more alignment marks 63 on a plate 61 is measured using the alignment microscope 12. A measurement end does not amend the error measured under the alignment microscope 12 in that case. If the position of the alignment marks 62 and 63 is taken along a horizontal axis and the measurement error of the direction of y is plotted on a vertical axis after an appropriate time, since the same result as drawing

7 is obtained, it can ask for dispersed flatness difference $\Delta h(i)$ of both the long picture mirror.

[0042] Next, it asks for flatness difference Δk of the long mirror in arbitrary positions x by compounding the mirror-plane configuration of each long mirror 7 and 8 the very thing measured with dispersed flatness difference $\Delta h(i)$ and the interferometer of both the long picture mirror as the 5th process. When flatness of the mask side long picture mirror 7 measured with the interferometer is set to $k_m(x)$ and flatness of the plate side long picture mirror 8 is set to $k_p(x)$, flatness difference Δk of both the long picture mirror in the posture measured with the interferometer $k(x)$ is $\Delta k(x) = k_m(x) - k_p(x)$.

It becomes.

[0043] Composition with flatness difference Δk of both the long picture mirror in the posture measured with dispersed flatness difference $\Delta h(i)$ and the interferometer of both the long picture mirror $k(x)$ each section $--$ it carries out by moving $\Delta k(x)$ in the direction of y , and expanding or reducing in the direction of y so that $\Delta k(x)$ may be divided into every i and $i+1$ and it may be in agreement with $\Delta h(i)$ and $\Delta h(i+1)$ at the ends of the section namely, $--$ if movement magnitude added to $\Delta k(x)$ for every section is set to $sft(i)$ and the inclination added for every section is set to $mag(i)$ $\Delta h(i) = \Delta k(x) + sft(i) + mag(i) \times (x - ixL)$

$[ixL \leq x \leq (i+1) \times L] \dots (17)$

It becomes.

[0044] In $x = ixL$ $\Delta h(i) = \Delta k(ixL) + sft(i) \dots (18)$

coming out $--$ it is $-- x = (i+1) \times L$ $--$ setting $-- \Delta h(i+1) = \Delta k((i+1) \times L) + sft(i) + mag(i) \times L \dots (19)$

Since come out and it is $sft(i) = \Delta h(i) - \Delta k(ixL) \dots (20)$

$mag(i) = [\Delta h(i+1) - \Delta k((i+1) \times L)]$

$- \Delta k(ixL) / L \dots (21)$

It becomes.

[0045] therefore, continuous flatness difference $\Delta h(x)$ of the long mirror in section $ixL \leq x \leq (i+1) \times L$ $\Delta h(x) = \Delta k(x) + sft(i) + mag(i) \times (x - ixL) \dots (22)$

It becomes. However, $sft(i)$ and $mag(i)$ are given by (20) and (21) formulas, respectively. Furthermore, if $sft(i)$ and $mag(i)$ are calculated by the entire interval, it can ask for continuous flatness difference $\Delta h(x)$ in arbitrary positions.

[0046] In addition, the interval L of cube-corner-reflector 19c and reflecting mirror 21c which were fixed to the mask stage 3 or when the interval L of cube-corner-reflector 20c and reflecting mirror 21e which were fixed to the plate stage 4 is narrowed fairly Between dispersed flatness difference $\Delta h(i)$ and $\Delta h(i+1)$ of a long mirror which adjoin mutually can also be interpolated to alignment, without measuring continuously the configuration of both the long picture mirror 7 and 8 the very thing. Moreover, when the continuous flatness of a long mirror divides and is measured by enlargement of a long mirror, as for Δk used in the section $[ixL \leq x \leq (i+1) \times L]$ of (22) formulas (x) , i.e., $k_m(x)$, $k_p(x)$, and $k(x)$, what was obtained by the same measurement is desirable.

[0047]

[Effect of the Invention] As mentioned above, according to the scanned type aligner and measuring method by this invention, a high exposure precision can be secured, without being dependent on the flatness of a long mirror.

TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to a scanned type aligner, and relates to amendment of the position gap with the mask stage and plate stage especially in the middle of a scanning.

EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, according to the scanned type aligner and measuring method by this invention, a high exposure precision can be secured, without being dependent on the flatness of a long mirror.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] The technology which carries out scanning exposure is indicated without making severe profile irregularity of the long mirror used as the criteria for measuring the relative position gap between the masks about a longitudinal direction and plates which intersect perpendicularly with the both sides of the normal of a mask, and a scanning direction to Japanese Patent Application No. No. 184113 [eight to] prolonged in the scanning direction, since it corresponds to enlargement of the latest liquid crystal substrate. however, in this technology, when the wave of a short period is in a long mirror, it is kept highly precise on the level which can disregard the strike slip between a mask and a plate -- there was un-arranging [that things did not have the result] this invention makes it a technical problem to offer the scanned type aligner which can carry out scanning exposure with high precision, and its technique in view of this trouble, without being based on the profile irregularity of a long mirror.

MEANS

[Means for Solving the Problem] If it matches and explains to drawing 1 which is made in order that this invention may solve the above-mentioned technical problem, and expresses one example The mask (5) with which the pattern was formed, and the projection optical system which projects the image of the pattern of the aforementioned mask on a sensitization substrate (6), In the scanned type aligner equipped with the 1st move mechanism in which the aforementioned mask and the aforementioned sensitization substrate are moved in the 1st direction which synchronizes and intersects perpendicularly with the optical axis of the aforementioned projection optical system to the aforementioned projection optical system The 1st reflecting mirror with the reflector which is fixed along the 1st direction of the above and counters with the predetermined end face of the aforementioned mask (7), The 2nd reflecting mirror with the reflector which is fixed along the 1st direction of the above and counters with the predetermined end face of the aforementioned sensitization substrate (8), The 1st interference system which detects the amount about the distance of the predetermined end face of the aforementioned mask, and the 1st reflecting mirror of the above according to the aforementioned movement by the aforementioned 1st move mechanism (1my, 1ck, 1x1, 1x2), The 2nd interference system (1py, 1ck, 1x1, 1x2) which detects the amount about the distance of the predetermined end face of the aforementioned sensitization substrate, and the 2nd reflecting mirror of the above according to the aforementioned movement by the aforementioned 1st move mechanism, It is the scanned type aligner characterized by establishing a storage means (26) to memorize the data about the flatness difference of the aforementioned reflector of the 1st reflecting mirror of the above, and the aforementioned reflector of the 2nd reflecting mirror of the above called for based on the detection result of the 1st interference system of

the above, and the 2nd interference system of the above.

[0004] While this invention projects the image of the pattern of a mask (5) on a sensitization substrate (6) by the projection optical system, again In the scanned type exposure method which is made to move the aforementioned mask and the aforementioned sensitization substrate in the 1st direction which synchronizes and intersects perpendicularly with the optical axis of the aforementioned projection optical system to the aforementioned projection optical system, and exposes the image of the pattern of the aforementioned mask The 1st reflecting mirror which has the predetermined end face of the aforementioned mask, and the reflector which counters, and was fixed along the 1st direction of the above (7), The 1st step which detects the amount about distance with the predetermined end face of the aforementioned mask according to the aforementioned movement, The 2nd reflecting mirror which has the predetermined end face of the aforementioned sensitization substrate, and the reflector which counters, and was fixed along the 1st direction of the above (8), The 2nd step which detects the amount about distance with the predetermined end face of the aforementioned sensitization substrate according to the aforementioned movement, It is the scanned type exposure method characterized by including the step which asks for the data about the flatness difference of the aforementioned reflector of the 1st reflecting mirror of the above, and the aforementioned reflector of the 2nd reflecting mirror of the above based on the above 1st and the detection result of the 2nd step.

[0005]

[Embodiments of the Invention] The gestalt of operation of this invention is explained using a drawing. The outline composition of one example of the scanned type aligner by this invention is shown in drawing 1 . In the following explanation, the system of coordinates which make a scanning direction, i.e., lengthwise, a x axis, make the y-axis the longitudinal direction which intersects perpendicularly in the same field as a mask 5 in a x axis, and make the direction of a normal of a mask 5 the z-axis are taken. The lighting light injected from the light sources (un-illustrating), such as an extra-high pressure mercury lamp, is led to 5 lighting optical system (un-illustrating) through an optical fiber (un-illustrating) etc. Each lighting optical system is constituted including a fly eye lens, a field diaphragm (un-illustrating), etc., respectively. Each lighting light injected from each lighting optical system illuminates uniformly the lighting fields 14a-14e where it differs on a mask 5. Each flux of light which passed the mask 5 exposes the exposure fields 15a-15e where it differs on the plate 6 which is a sensitization substrate through the projection optical system PL with the five projection lens sections which perform image formation of actual size erection, respectively (refer to drawing 9), and carries out image formation of the image of the pattern of the lighting fields 14a-14e on a mask 5 on a plate 6 in this way. Although each lighting fields 14a-14e are separated, respectively and it is arranged, the addition width of face which integrated the width of face of the x directions of each lighting fields 14a-14e in the x directions is formed so that it may continue in the direction of y with the same width of face.

[0006] Each lighting optical system and each projection optical system are supported with the stand 1. The carriage 2 by which a run drive is carried out is carried in the x directions by the driving gear (un-illustrating) at the stand 1, and the mask stage 3 and the plate stage 4 are held at this carriage 2. The mask 5 is held at the mask stage 3, the plate 6 is held on the plate stage 4, and the whole pattern on a mask 5 is imprinted on a plate 6 by scanning carriage 2 in the x directions in this way. The mask stage 3 is constituted so that it may be supported by carriage 2 through the jogging machines 9-11, namely, the position of the x directions of a mask stage 3 may be moved slightly with the x direction jogging machine 9 and the position of the direction of y of a mask stage 3 and the hand of cut of the

circumference of the z-axis can be moved slightly with the direction jogging machines 10 and 11 of y.

[0007] On the other hand, in order to amend the influence of the thickness nonuniformity of a plate 6, or an inclination and to make it simultaneously in agreement with the image formation side of a mask pattern, the plate stage 4 is supported by carriage 2 through the three or more direction jogging machines (un-illustrating) of z, and it is constituted so that jogging (auto-focusing) of the direction of z and the degree of tilt angle of the circumference of a x axis and the circumference of the y-axis (auto leveling) can be adjusted in this way. Moreover, the long mirror 7 for masks and the long mirror 8 for plates are being fixed to the stand 1. Both the long picture mirrors 7 and 8 are reflecting mirrors prolonged for a long time in the x directions, and the normal of the reflector has turned to the direction of y. The long mirror 7 for masks counters a mask stage 3, and is arranged, and the long mirror 8 for plates counters the plate stage 4, and is arranged.

[0008] Drawing 9 is the perspective diagram which expressed the scanned type aligner of drawing 1 partially. The projection optical system PL has the five projection lens sections arranged alternately in order to project the flux of light which passed through each field of the lighting fields 14a-14e on a plate 6. In addition, on behalf of the five projection lens sections, it expresses with drawing 9 the projection optical system PL, and the optical axis of a projection optical system PL is indicated to be AX. It is arranged along the direction of X the long mirror 7 for masks and whose long mirror 8 for plates are the 1st direction which intersects perpendicularly with the optical axis AX of a projection optical system PL so that clearly from drawing 9.

[0009] It returns to drawing 1 and the position and posture of a mask stage 3 and the plate stage 4 are supervised as follows by six interferometers Ix1, Ix2, Icx, Imy, Ipy, and Ick. The differential type interferometer Ix1 is first for measuring a relative position gap (vertical gap) of the x directions of a mask stage 3 and the plate stage 4. Namely, the laser beam bunch injected from the laser light source (un-illustrating) fixed to the stand 1 It is divided by beam-splitter 16a fixed to the stand 1, and each divided flux of light Reflect with the reflecting mirrors 16b and 16d fixed to the stand 1, respectively, and it is fixed to a mask stage 3 and the plate stage 4, respectively, and reflects with reflecting mirrors 16c and 16e. It reverses, is compounded by beam-splitter 16a, and interferes in an outward trip, and incidence is carried out to the receiver (un-illustrating) of an interferometer Ix1.

[0010] An interferometer Ix1 is for measuring a relative position gap (vertical gap) of the x directions of a mask stage 3 and the plate stage 4 in the position where the differential type interferometers Ix2 differ in the direction of y. That is, the laser beam bunch for interferometer Ix2 is divided by beam-splitter 17a, and it reflects with reflecting mirrors 17b and 17d, respectively, is fixed to a mask stage 3 and the plate stage 4, respectively, and reflects with reflecting mirrors 17c and 17e, and each divided flux of light reverses, is compounded by beam-splitter 17a, and carries out incidence of the outward trip to the receiver of an interferometer Ix2. In addition, an interval with the reflecting mirrors 16c and 17c fixed to the mask stage 3 and the interval with the reflecting mirrors 16e and 17e fixed to the plate stage 4 are equal, and set this interval to H henceforth. As for the position of the reflecting mirrors 16c and 17c on a mask stage 3, and the reflecting mirrors 16e and 17e on the plate stage 4, it is desirable that it is in the equal distance from the center of each stages 3 and 4.

[0011] The measured type interferometer Icx of the length is for measuring the travel of carriage 2. The laser beam bunch for Interferometers Icx is divided by beam-splitter 18a, and namely, each divided flux of light Reflect with the reflecting mirrors 18b and 18d fixed to the stand 1, respectively, and one flux of light is reflected by reflecting mirror 18c fixed on the mask stage 3. Reflecting the flux of light of another side by fixed mirror 18e fixed to

the projection optical system, it reverses, is compounded by beam-splitter 18a, and interferes in an outward trip, and both the flux of lights carry out incidence to the receiver of Interferometer Icx. In this way, by Interferometer Icx, the distance of the x directions of a mask stage 3 and fixed mirror 18e is measured.

[0012] The measured type interferometer I_{my} of the length is for measuring the distance of the direction of y of a mask stage 3 and the long mirror 7 for masks. Moreover, the measured type interferometer I_{py} of the length is for measuring the distance of the direction of y of the plate stage 4 and the long mirror 8 for plates. Since both the interferometers I_{my} and I_{py} are the same composition, the explanation about Interferometer I_{my} is indicated out of a parenthesis, and the explanation about Interferometer I_{py} is indicated in a parenthesis. That is, the laser beam bunch for interference systems I_{my} (I_{py}) is divided into the two flux of lights by beam-splitter 19a (20a) fixed to the mask stage 3 (plate stage 4). this -- two -- a ** -- the flux of light -- inside -- a beam splitter -- 19 -- a (20a) -- having penetrated -- the flux of light -- a mask stage -- three (plate stage 4) -- a top -- arranging -- having had -- λ -- / -- four -- a board -- 19 -- d (20d) -- a passage -- a mask stage -- three (plate stage 4) -- a top -- arranging -- having had -- a reflecting mirror -- 19 -- b (20b) -- reflecting -- again -- The flux of light which passed along 19d (20d) of $\lambda/4$ boards Beam-splitter 19a (20a), Cube-corner-reflector 19c arranged on the mask stage 3 (plate stage 4) (20c), beam-splitter 19a (20a) -- respectively -- reflecting -- 19d (20d) of $\lambda/4$ boards -- a passage -- reflecting mirror 19b (20b) -- reflecting -- 19d (20d) of $\lambda/4$ boards, and beam-splitter 19a (20a) -- respectively -- a passage -- an interference system I_{my} (I_{py}) -- incidence is carried out to a receiver

[0013] the flux of light reflected up by beam-splitter 19a (20a) of the flux of lights divided by beam-splitter 19a (20a) -- $\lambda/4$ board 19e (20e) -- a passage -- the long mirror 7 (8) -- reflecting -- $\lambda/4$ board 19e (20e), and beam-splitter 19a (20a) -- respectively -- a passage -- cube-corner-reflector 19c (20c) -- reflecting . the flux of light reflected by cube-corner-reflector 19c (20c) -- beam-splitter 19a (20a), and $\lambda/4$ board 19e (20e) -- respectively -- a passage -- the long mirror 7 (8) -- reflecting -- $\lambda/4$ board 19e (20e) - - a passage -- beam-splitter 19a (20a) -- reflecting -- having -- an interference system I_{my} (I_{py}) -- incidence is carried out to a receiver Thereby, the flux of light divided into the two flux of lights by beam-splitter 19a (20a) is again compounded by beam-splitter 19a (20a), and it interferes in it, and it carries out incidence to a receiver.

[0014] The differential type interferometer I_{ck} is for measuring a relative position gap of the direction of y of a mask stage 3 and the plate stage 4 through both the long picture mirrors 7 and 8. That is, the laser beam bunch for Interferometers I_{ck} is divided by beam-splitter 21a, each divided flux of light is reflected with the reflecting mirrors 21b and 21d fixed to the stand 1, respectively, it reflects by reflecting mirror 21c on a mask stage 3, and one flux of light is reflected in the long mirror 7 for masks. It reflects by reflecting mirror 21e on the plate stage 4, and the flux of light of another side is reflected in the long mirror 8 for plates. Both the flux of lights reverse, are compounded by beam-splitter 21a, interfere in an outward trip, and carry out incidence to the receiver of Interferometer I_{ck}. In addition, the interval of the x directions of cube-corner-reflector 20c and reflecting mirror 21e which were fixed to the interval and the plate stage 4 of the x directions of cube-corner-reflector 19c and reflecting mirror 21c which were fixed to the mask stage 3 is equal, and sets this interval to L henceforth.

[0015] The position of carriage 2 is set to x, the relative amount of position gaps of the x directions of a mask stage 3 and the plate stage 4 (the amount of vertical gaps) is set to ΔX (x), the relative amount of position gaps of the direction of y (the amount of strike slips) is set to ΔY (x), and the relative amount of angle gaps of the circumference of the z-axis is set to ΔT (x). Moreover, the flatness difference of both the long picture mirrors

7 and 8 is set to $\Delta h(x)$. Flatness difference Δh is the relative amount of position gaps of the direction of y of the reflector of the long mirror 7 for masks, and the reflector of the long mirror 8 for plates (the amount of strike slips). When the measurement value of each interferometers I_{x1} , I_{x2} , I_{cx} , I_{my} , I_{py} , and I_{ck} is expressed as I_{x1} , I_{x2} , I_{cx} , I_{my} , I_{py} , and I_{ck} using the respectively same character, it is $\Delta X(x) = (I_{x1} + I_{x2})/2$ (1)

$\Delta T(x) = (I_{x1} - I_{x2})/H$ (2)

$\Delta Y(x) = I_{my} - I_{py} - \Delta h(x)$ (3)

It becomes.

[0016] The value of angle gap ΔT of vertical gap ΔX of (1) formula and (2) formulas is immediately acquired from the measurement value of interferometers I_{x1} and I_{x2} among the above-mentioned (1) - (3) formulas. Moreover, about strike slip ΔY of (3) formulas, flatness difference Δh is stored in the storage 26 in a control unit 25 as a function of the position x of carriage 2, and strike slip ΔY is calculated from this $\Delta h(x)$ and measurement value of Interferometers I_{my} and I_{py} . In this way, the relative physical relationship of the mask stage 3 at the time of scanning exposure and the plate stage 4 is kept constant by driving the jogging machines 9-11 and tuning the position of a mask stage 3 finely in a x-y side with a control unit 25, to vertical gap ΔX in a x-y side, strike slip ΔY , and angle gap ΔT .

[0017] How to ask below for flatness difference Δh of both the long picture mirrors 7 and 8] $h(x)$ is explained. This flatness difference $\Delta h(x)$ is dependent on the installation posture to the mirror-plane configuration of each long mirror 7 and 8 the very thing, and the stand 1 of each long mirrors 7 and 8. this example measures continuously the mirror-plane configuration of each long mirror 7 and 8 the very thing in one side. By measuring dispersedly flatness difference Δh when attaching each long mirrors 7 and 8 in a stand 1 in another side] $h(x)$, and interpolating the inside of each section of flatness difference Δh for which after an appropriate time was asked dispersedly with the difference of the continuous configuration of both the long picture mirrors 7 and 8 It asks for flatness difference Δh as a continuous function of x.

[0018] Then, how to search for continuously the mirror-plane configuration of each long mirror 7 and 8 the very thing is explained first. Drawing 2 is drawing having shown the outline for measuring continuously the profile irregularity of each long mirrors 7 and 8. It is efficient to perform this measurement to serve both as a check and measurement of profile irregularity at the time of the polish end of the long mirrors 7 and 8 before the inclusion to a stand 1. Moreover, as for the posture of the long mirrors 7 and 8 at the time of measurement, it is desirable to suppose that it is the same as that of the posture when including in a stand 1.

[0019] The laser beam bunch injected from the laser light source 30 can extend **** with the beam expander 31, and serves as a parallel ray through a lens 32. Subsequently, a laser beam penetrates a one-way mirror 33, it reflects in respect of [35] the reference prepared in the last side of the Fizeau element, and a part of transmitted light reverses an outward trip, and it returns to a one-way mirror 33. The rear face 34 of the reference side 35 is coated with the antireflection film. On the other hand, it reflects in the long mirror 7 (or long mirror 8 for plates) for masks, and the laser beam which penetrated the reference side 35 reverses an outward trip, and returns to a one-way mirror 33. It interferes, and reflects by the one-way mirror 33, and the laser beam reflected in respect of [35] reference and the laser beam reflected in the long mirror 7 (8) reach a detector 36. In this way, it becomes possible to be able to measure the profile irregularity of the long mirror 7 (8) to the reference side 35 with a detector 36, namely, to ask for the flatness in the arbitrary points of the long mirror 7 (8).

[0020] In addition, although, as for the long mirror 7 (8), a bird clapper is expected for a

long time with enlargement of a liquid crystal substrate, when it becomes longer than the reference side 35, the whole surface can be measured by shifting the long mirror 7 (8) and measuring multiple times. However, it is necessary to make the measure point by the interferometers I_{my} , I_{py} , and I_{ck} later mentioned in this case overlap, and to measure. Moreover, although the Fizeau interferometer was used for measurement of the profile irregularity of the long mirror 7 (8) in drawing 2, the measurement method was not restricted to this.

[0021] Next, how to measure the flatness difference of a long mirror dispersedly is explained. Measurement is measured at every fixed measurement interval L , scanning carriage 2. A measurement end fixes a mask stage 3 and the plate stage 4 relatively, namely, the jogging machines 9-11 do not drive it. Let the interval L which measures be the interval of the x directions of the position which the flux of light of Interferometer I_{my} or Interferometer I_{py} reflects in the long mirror 7 or the long mirror 8, and the position which the flux of light of Interferometer I_{ck} reflects in the long mirror 7 or the long mirror 8. Measurement is performed as follows. The value of the interferometers I_{my} , I_{py} , and I_{ck} when moving carriage 2 to the end of the long mirrors 7 and 8 is measured. Subsequently, measuring the position of carriage 2 with Interferometer I_{cx} , only L moves the position of carriage 2 and the value of Interferometers I_{my} , I_{py} , and I_{ck} is measured in the position. Like the following, whenever only L moves the position of carriage 2, the value of Interferometers I_{my} , I_{py} , and I_{ck} is measured.

[0022] Below, since it is easy, the measurement value of the interferometers I_{my} , I_{py} , and I_{ck} in the dispersed measurement position i on a long mirror is marked as $I_{my}(i)$, $I_{py}(i)$, and $I_{ck}(i)$, respectively. That is, when a dispersed position is meant, Variable i is used, and Variable x is used when a continuous position is meant. In addition, in the position of the same carriage 2, $I_{my}(i)$, $I_{py}(i)$, and $I_{ck}(i-1)$ are measured clearly. Moreover, the value of the interferometer in a measurement starting position is set to $I_{my}(1)$, $I_{py}(1)$, and $I_{ck}(0)$.

[0023] Interferometer I_{my} is measuring the distance of the direction of y of a mask stage 3 and the long mirror 7 for masks, and Interferometer I_{py} is measuring the distance of the direction of y of the plate stage 4 and the long mirror 8 for plates. Therefore, the rolling error (rotation of the circumference of a x axis) of carriage 2 and the offset at the time of interferometer reset are included in the measurement value of both these interferometers I_{my} and I_{py} in addition to flatness difference Δh of both the long picture mirrors 7 and 8. The flatness difference of both the long picture mirror in the measurement position i is set to $\Delta h(i)$, the amount of rolling is set to $r(i)$, and the offset at the time of reset of both the interferometers I_{my} and I_{py} is set to A and B , respectively.

[0024] It is newly $I_y(i) = I_{my}(i) - I_{py}(i)$ about $I_y(i)$ as a difference of the measurement value of both the interferometers I_{my} and $I_{py}(i)$ (4)

A definition materializes the following formula.

$$I_y(i) = I_{my}(i) - I_{py}(i) = \Delta h(i) + r(i) + A - B \dots (5)$$

(5) Among a formula, $I_y(i)$ is measured value and the right-hand side's is strange.

[0025] Moreover, Interferometer I_{ck} is measuring the position gap of the direction of y of a mask stage 3 and the plate stage 4 through both the long picture mirrors 7 and 8. Therefore, the position gap resulting from vertical gap ΔX of a mask stage 3 and the plate stage 4 and angle gap ΔT of the circumference of the z -axis other than the offset C at the time of the error r resulting from flatness difference Δh of both the long picture mirrors 7 and 8 and rolling of carriage 2 and interferometer reset is further included in the measurement value of Interferometer I_{ck} . Moreover, the amount of rolling contained in the measurement value of the interferometers I_{my} , I_{py} , and I_{ck} measured simultaneously is equal. Therefore, $I_{ck}(i-1)$ is expressed with the following formula.

$$Ick(i-1) = \text{deltah}(i-1) + r(i) + C + \text{deltaX}(i-1) + \text{deltaT}(i-1) - H \dots (6)$$

[0026] Since vertical gap deltaX and angle gap deltaT are measured value, if they define Ick' by (7) formulas, (6) formulas will turn into (8) formulas.

$$Ick'(i) \text{ ** } -- Ick(i) - \text{deltaX}(i) - \text{deltaT}(i) - H \dots (7)$$

$$Ick'(i-1) = \text{deltah}(i-1) + r(i) + C \dots (8)$$

(8) Among a formula, $Ick'(i-1)$ is measured value, and the right-hand side's is strange.

[0027] Furthermore, if (9) formulas define deltaH in order to eliminate the error r resulting from rolling of carriage 2, deltaH will become like (5) formulas and (8) formulas to (10) formulas.

$$\text{deltaH}(i) \text{ ** } Iy(i) - Ick'(i-1) \dots (9)$$

$$\text{deltaH}(i) = \text{deltah}(i) - \text{deltah}(i-1) + A - B - C \dots (10)$$

(10) Among a formula, $\text{deltaH}(i)$ is calculated from the measurement value of interferometers I_{my} , I_{py} , I_{x1} , and I_{x2} , and the right-hand side's is strange.

[0028] If the sum from $i=1$ to $i=k$ ($k \geq 1$) of $\text{deltaH}(i)$ is set to $S(k)$ and the position k of a long mirror is newly marked as a position i $S(i) \text{ ** } \text{deltaH}(1) + \text{deltaH}[\dots (11a)] (2) + \dots + \text{deltaH}(i)$

$$S(i) = \text{deltah}(1) - \text{deltah}(0) + A - B - C + \text{deltah}(2) - \text{deltah}(1) + A - B - C + \dots + \text{deltah}(i) - \text{deltah}(i-1) + A - B - C = \text{deltah}(i) - \text{deltah}(0) + (A - B - C) \text{ xi } (i \geq 1)$$

.... (11b)

It becomes. (11b) Among a formula, $S(i)$ is measured value and the right-hand side's is strange. flatness difference $\text{delta}[\dots]$ of a long mirror / in / a position i / in this way (11b) / from a formula] / $h(i) \text{ delta } -- h(i) = S(i) + \text{deltah}(0) - (A - B - C) \text{ xi } (i \geq 1)$

.... (12)

It becomes. If it sets with $S(0) \text{ ** } 0$ at the time of $i=0$, (12) formulas will be realized also at the time of $i=0$.

[0029] (12) Among the right-hand side of a formula, $S(i)$ is measured value and $\text{deltah}(0)$ and $x(A - B - C)$ are unknowns. Among these, since $\text{deltah}(0)$ is always fixed offset irrespective of the measurement position i of a long mirror, it does not become an error by amount of strike slips $\text{delta}[\dots]$ between a mask stage 3 and the plate stage 4] Y's (x)'s not changing, namely, carrying out alignment of a mask stage 3 and the plate stage 4 so that more clearly than (3) formulas. On the other hand, since $x(A - B - C)$ changes to alignment depending on the position i of a long mirror, it needs to ask for the coefficient $(A - B - C)$. Then, how to ask for a coefficient $(A - B - C)$ next is shown.

[0030] First, as the 1st process, in order to measure S in (12) formulas (i), carriage 2 is scanned and the measurement value of each interferometer is measured. At this time, amount of vertical gaps deltaX between a mask stage 3 and the plate stage 4 is continuously measured by (1) formula like previous statement, and amount of angle gaps deltaT in a x-y side can scan carriage 2, keeping constant these amounts deltaX and deltaT of gaps, since it is continuously measured by (2) formulas. However, flatness difference $\text{deltah}(x)$ is not only strange, but since discrete-value $\text{deltah}(i)$ is strange, amount of strike slips deltaY cannot keep amount of strike slips deltaY constant. Then, first, carriage 2 is scanned without performing adjustment of a strike slip at all, and $x=0$ at that time, L , $2xL$, ..., ixL , the measurement value I_{my} of Interferometers I_{my} and I_{py} in .. (i), and $I_{py}(i)$ are measured. Subsequently, as the 2nd process, it asks for $S(i)$ by the formula (11a).

[0031] Subsequently, as the 3rd process, in order to calculate $(A - B - C)$ in (12) formulas, the mask 40 for error measurement shown in drawing 3 is set to a mask stage 3, the plate for error measurement is set to the plate stage 4, and 1st scanning exposure is performed.

However, although S in (12) formulas (i) became known, since the coefficient $(A - B - C)$ is strange, it disregards this coefficient $(A - B - C)$, namely, it is $\text{deltah}(i) = S$ as a provisional formula of the flatness difference of both the long picture mirror (i). (13)

*****. Moreover, since i is a discrete value, it interpolates between $\delta h(i)$ and $\delta h(i+1)$ by the primary formula. That is, the relation between the measurement position i and the position x of the carriage 2 measured with Interferometer I_{cx} is expressed with the following formula when the value of the interferometer I_{cx} in a measurement starting position is set to 0.

$$x = ixL \dots (14)$$

[0032] Therefore, provisional formula δh of the flatness difference of both the long picture mirror in case carriage 2 is between the measurement position i on a long mirror and $i+1$] $h(x)$ is expressed with the following formula.

$$\delta h(x) = [\delta h(i+1) - \delta h(i)] \times (x/L - i) + \delta h(i) \dots (15)$$

Carriage 2 is scanned asking for amount of strike slips δY between a mask stage 3 and the plate stage 4, and keeping constant this amount of strike slips δY by (3) formulas, since the estimate of the flatness difference of both the long picture mirror is continuously obtained by (13) formulas and (15) formulas in this way.

[0033] Drawing 3 shows the mask 40 for error measurement, and two or more marks 41 are drawn by this mask 40 in the x directions at one train, and are drawn in the direction of y again at every interval L . As for the interval of the direction of y of a mark 41, it is desirable to make it in agreement with the measurement interval L in dispersed flatness measurement of both the long picture mirror. Drawing 4 shows the enlarged view of one mark 41, and is a pattern for exposure position detection. In this drawing, the slash section is a shading field and a cross-like portion is a light transmission field. Although the cross hair was used for exposure position detection here, what mark may be used as long as it is the mark which can detect an exposure position. Moreover, the alignment marks 42 and 43 for masks of a couple and the alignment marks 44 and 45 for plates of a couple are drawn by the mask 40 for error detection. both the marks 42 and 43; -- it shifts a little to the both sides of x directions and the direction of y , and 44 and 45 are arranged to them, as shown in drawing 3

[0034] A plate is developed after scanning exposure of a mask 40. As shown in a plate 48 at drawing 5, the imprint mark (un-illustrating) of the alignment marks 42 and 43 for masks and the imprint marks 46 and 47 of the alignment marks 44 and 45 for plates other than the imprint mark 49 of two or more marks 41 are imprinted. Subsequently, both a mask 40 and a plate are rotated 90 degrees, it sets to a mask stage 3 and the plate stage 4, respectively, and alignment of the alignment marks 42 and 43 for masks on a mask 40 and the alignment mark imprint marks 46 and 47 for plates on a plate 48 is performed. namely, both the marks 42 and 43; -- the relative position error of 46 and 47 -- the alignment microscopes 12 and 13 -- measuring -- the mark motives 9-11 -- driving -- both the marks 42 and 43; -- the position of 46 and 47 is doubled and 2nd exposure is performed after an appropriate time

[0035] It shifts in the alignment marks 42 and 43 for masks on a mask 40, the alignment marks 44 and 45x for plates, and the direction of y a little, and is arranged, and alignment of the alignment marks 42 and 43 for masks and the imprint mark of the alignment mark for plates was carried out at the time of the 2nd exposure. Therefore, between the 1st exposure and the 2nd exposure, it means that only the interval of the alignment marks 42 and 43 for masks and the alignment marks 44 and 45 for plates had shifted and exposed the mask 40 and the plate 48.

[0036] Consequently, the image 49 of two or more marks 41 obtained by two exposure turns into an image with two cross hairs, as shown in drawing 6. The amount of gaps of the net between both cross hairs can be known by measuring the interval of both cross hairs under a microscope etc., and deducting the amount of position gaps of a mask 40 and a

plate 48 from this measured value. Control of the jogging machines 9-11 is correctly controlled in the x directions, and is controlled by the provisional formula in the direction of y here. Therefore, between a mark 41 and its image, there is no gap in the x directions and only the error by having controlled by the provisional formula produces a position gap in the direction of y. Namely, in the 1st exposure, since there is no gap between a mark 41 and its image in the x directions and it was rotating 90 degrees at the time of the 2nd exposure, speaking of the arrangement at the time of the 2nd exposure, there is no gap between a mark 41 and its 1st image in the direction of y. Moreover, between a mark 41 and its 2nd image, only the error by having controlled by the provisional formula in the direction of y produces a position gap about the arrangement at the time of the 2nd exposure. Therefore, by measuring the amount of gaps of the net of the direction of y between both cross hairs, the error by having controlled by the provisional formula can be known.

[0037] Subsequently, it asks for a coefficient (A-B-C) as the 4th process. Drawing 7 is drawing which took the position i of a mark 41 along the horizontal axis, and plotted the amount of position gaps of the net of the direction of y, i.e., a longitudinal direction, on the vertical axis. The amount of position gaps of lateral net is $-\Delta h(0) + (A-B-C) \cdot x_i$ (16) Since it becomes, if it asks for a regression line 50 from the point which drawing 7 plotted, the inclination will serve as a coefficient (A-B-C). It can ask for dispersed flatness difference $\Delta h(i)$ of both the long picture mirror from (12) formulas in this way.

[0038] In addition, in each measure point where control of the jogging machine in the 3rd process measured S (i), the right control is performed except for the point that $x(A-B-C) \cdot i$ is disregarded. Therefore, as for the measure point which measures the net amount of strike slips, it is desirable to make it in agreement with the measure point when asking for S (i). It is because there is a possibility that elements other than $x(A-B-C) \cdot i$ may be added when the net amount of strike slips is measured points other than the measure point when asking for S (i). In order to make in agreement the measure point which measures the net amount of strike slips, and the measure point when asking for S (i), it is necessary to make the interval of a mark 41 first in agreement with the measurement interval L when asking for S (i). Subsequently, what is necessary is to set a mask 40 by arrangement of the 2nd exposure, and just to let the place which moved carriage by the integral multiple of L be a criteria position from the place whose mark 41 on a mask 40 corresponds with an exposure position, in case you decide the criteria position of the scanning direction of carriage 2, in order to make the measure point itself in agreement. In addition, naturally you may reverse the sequence of the 1st exposure and the 2nd exposure.

[0039] Moreover, when the measure point which measures the net amount of strike slips in this way, and the measure point when asking for S (i) are made in agreement, especially control of the jogging machine in the mid-position of each measure point does not pose a problem. Therefore, although between each measure point was only interpolated to alignment in this example, between each measure point can also be interpolated according to the actual flatness difference of both the long picture mirror, for example. Thus, the technique of interpolating between each measure point according to the actual flatness difference of both the long picture mirror is effective when it is difficult to make in agreement the measure point which measures the net amount of strike slips, and the measure point when asking for S (i).

[0040] Moreover, by two exposure, it can replace with the method of measuring a position gap of the direction of y dispersedly, and a position gap of the direction of y can also be measured dispersedly as follows, without exposing. That is, as it is indicated in (b) as drawing 8 (a), to the mask [for error measurement] 60, and end side of the direction of y of a plate 61, two or more alignment marks 62 and alignment marks 63 are arranged in the

x directions at intervals of L, respectively, and alignment mark 62b and alignment mark 63b are arranged at the other end side of the direction of y, respectively. Positioning of a mask 60 and a plate 61 is performed by setting this mask 60 and plate 61 to a mask stage and a plate stage, respectively, carrying out alignment of one alignment mark 62a of two or more alignment marks 62 on a mask 60, and the one alignment mark 63a of two or more alignment marks 63 on a plate 61, and carrying out alignment of alignment mark 62b on a mask 60, and the alignment mark 63b on a plate 61.

[0041] Subsequently, amount of vertical gaps ΔX is correctly controlled by (1) formula, amount of angle gaps ΔT in a x-y side is correctly controlled by (2) formulas, and amount of strike slips ΔY scans carriage 2, controlling by (3) formulas using the provisional formula of the flatness difference of both the long picture mirror obtained by (13) formulas and (15) formulas. And the error of the direction of y of two or more alignment marks 62 on a mask 60 and two or more alignment marks 63 on a plate 61 is measured using the alignment microscope 12. A measurement end does not amend the error measured under the alignment microscope 12 in that case. If the position of the alignment marks 62 and 63 is taken along a horizontal axis and the measurement error of the direction of y is plotted on a vertical axis after an appropriate time, since the same result as drawing 7 is obtained, it can ask for dispersed flatness difference $\Delta h(i)$ of both the long picture mirror.

[0042] Next, it asks for flatness difference Δh [of the long mirror in arbitrary positions] h (x) by compounding the mirror-plane configuration of each long mirror 7 and 8 the very thing measured with dispersed flatness difference $\Delta h(i)$ and the interferometer of both the long picture mirror as the 5th process. When flatness of the mask side long picture mirror 7 measured with the interferometer is set to $k_m(x)$ and flatness of the plate side long picture mirror 8 is set to $k_p(x)$, flatness difference Δh [of both the long picture mirror in the posture measured with the interferometer] k (x) is $\Delta h(x) = k_m(x) - k_p(x)$. It becomes.

[0043] Composition with flatness difference Δh [of both the long picture mirror in the posture measured with dispersed flatness difference $\Delta h(i)$ and the interferometer of both the long picture mirror] k (x) each section [-- it carries out by moving $\Delta h(x)$ in the direction of y, and expanding or reducing in the direction of y so that $\Delta h(x)$ may be divided into every i and i+1] and it may be in agreement with $\Delta h(i)$ and $\Delta h(i+1)$ at the ends of the section namely, -- if movement magnitude added to $\Delta h(x)$ for every section is set to $sft(i)$ and the inclination added for every section is set to $mag(i)$ $\Delta h(i) = \Delta h(x) + sft(i) + mag(i) \times (x - ixL)$

$[ixL \leq x \leq (i+1) \times L] \dots (17)$

It becomes.

[0044] In $x = ixL$ $\Delta h(i) = \Delta h(ixL) + sft(i) \dots (18)$

coming out -- it is -- $x = (i+1) \times L$ -- setting -- $\Delta h(i+1) = \Delta h(i+1)(xL) + sft(i) + mag(i) \times L \dots (19)$

Since come out and it is $sft(i) = \Delta h(i) - \Delta h(ixL) \dots (20)$

$mag(i) = [\Delta h(i+1) - \Delta h(i+1)(xL)]$

$- \Delta h(i) + \Delta h(ixL)] / L \dots (21)$

It becomes.

[0045] therefore, continuous flatness difference $\Delta h(x)$ of the long mirror in section $ixL \leq x \leq (i+1) \times L$ $\Delta h(x) = \Delta h(x) + sft(i) + mag(i) \times (x - ixL) \dots (22)$

It becomes. However, $sft(i)$ and $mag(i)$ are given by (20) and (21) formulas, respectively. Furthermore, if $sft(i)$ and $mag(i)$ are calculated by the entire interval, it can ask for continuous flatness difference $\Delta h(x)$ in arbitrary positions.

[0046] In addition, the interval L of cube-corner-reflector 19c and reflecting mirror 21c which were fixed to the mask stage 3 or when the interval L of cube-corner-reflector 20c and reflecting mirror 21e which were fixed to the plate stage 4 is narrowed fairly. Between dispersed flatness difference $\delta h(i)$ and $\delta h(i+1)$ of a long mirror which adjoin mutually can also be interpolated to alignment, without measuring continuously the configuration of both the long picture mirror 7 and 8 the very thing. Moreover, when the continuous flatness of a long mirror divides and is measured by enlargement of a long mirror, as for δk used in the section $[ixL \leq x \leq (i+1) \times L]$ of (22) formulas (x) , i.e., km, (x) , and $k_p(x)$, what was obtained by the same measurement is desirable.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The perspective diagram showing the composition of one example of the scanned type aligner by this invention

[Drawing 2] The plot plan when measuring the profile irregularity of a long mirror continuously

[Drawing 3] The plan showing the mask used in order to measure the error produced by the provisional formula

[Drawing 4] The enlarged view showing the mark used for the mask for error measurement

[Drawing 5] The plan showing the plate with which the mark of the mask for error measurement was imprinted

[Drawing 6] The enlarged view showing the image of the mark imprinted by two exposure

[Drawing 7] Explanatory drawing showing the exposure distribution of errors

[Drawing 8] The plan showing another (a) mask used in order to measure the error produced by the provisional formula, and the (b) plate

[Drawing 9] It is the perspective diagram which expressed the scanned type aligner of drawing 1 partially.

[Brief Description of Notations]

1 -- Stand 2 -- Carriage

3 -- Mask stage 4 -- Plate stage

5 -- Mask 6 -- Plate

7 -- Long mirror for masks 8 -- Long mirror for plates

9, 10, 11 -- Mark motive 12 13 -- Alignment microscope

14a-14e -- Mask lighting field 15a - 15e plate exposure field

1x1, 1x2, 1cx, 1my, 1py, 1ck -- Interferometer

16a, 17a, 18a, 19a, 20a, 21a -- Beam splitter

16b-16e, 17b-17e, 18b-18e -- Reflecting mirror

19b, 20b, 21b-21e -- Reflecting mirror

19c, 20c -- Cube corner reflector

19d, 19e, 20d, 20 e-- $\lambda/4$ board

25 -- Control unit 26 -- Storage

30 -- Laser light source 31 -- Beam expander

32 -- Lens 33 -- One-way mirror

34 -- Rear face 35 -- Reference side

36 -- Detector

40 -- Mask for error measurement 41 -- Mark

42 43 -- Alignment mark for masks

44 45 -- Alignment mark for plates

46 47 -- Alignment mark imprint mark for plates

48 -- Plate for error measurement 49 -- Mark imprint mark
50 -- Regression line
60 -- Mask for error measurement 61 -- Plate for error measurement
62 63 -- Alignment mark

DRAWINGS

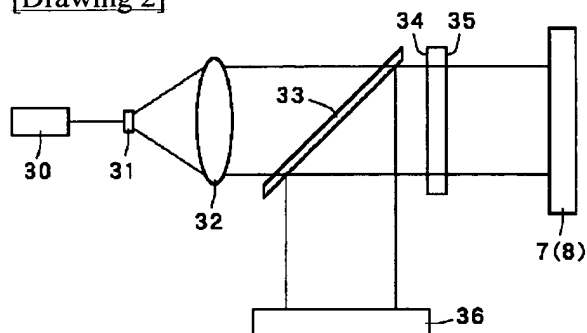
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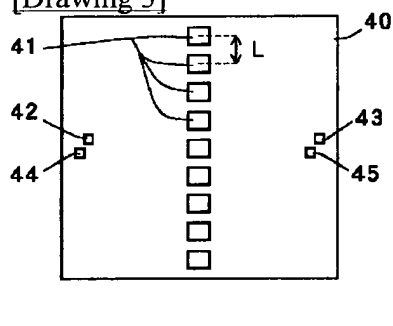
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2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

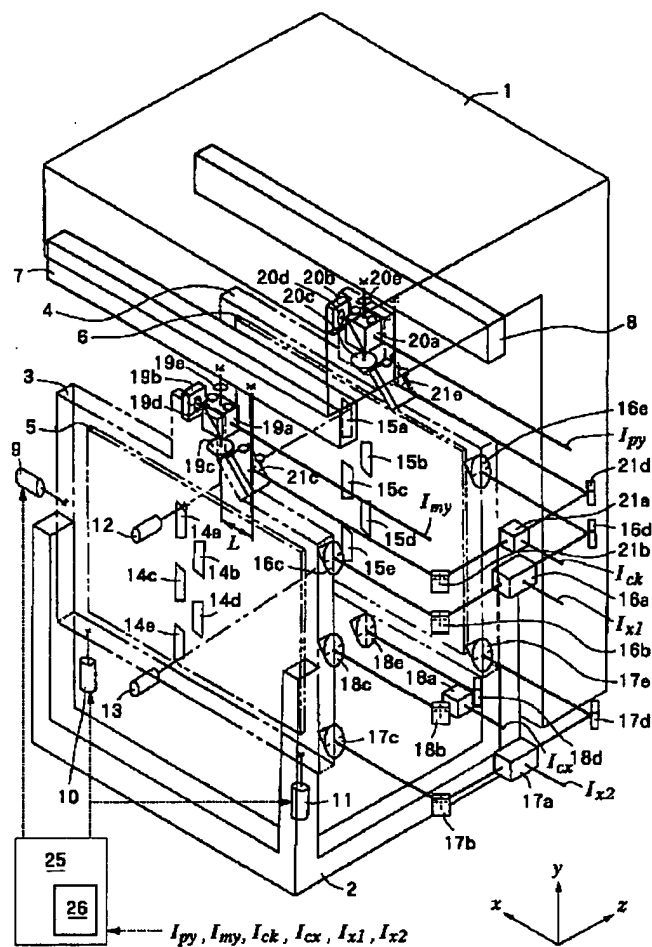
[Drawing 2]



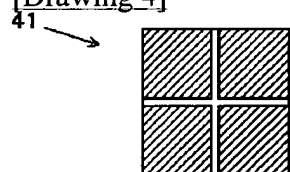
[Drawing 3]



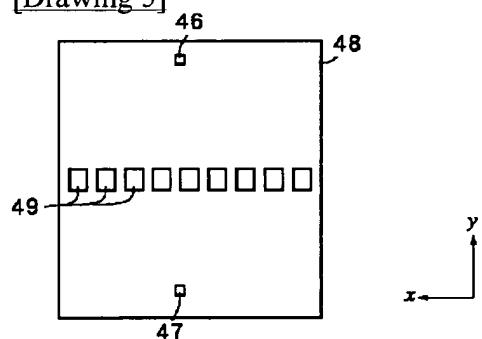
[Drawing 1]



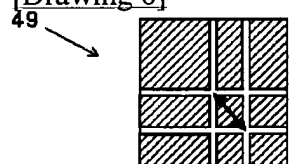
[Drawing 4]



[Drawing 5]

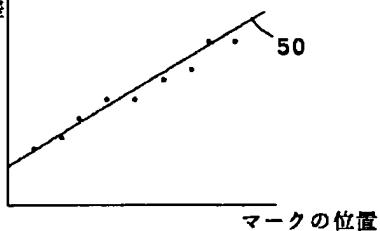


[Drawing 6]



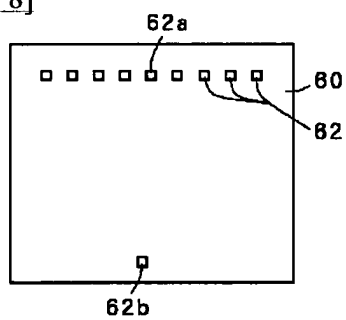
[Drawing 7]

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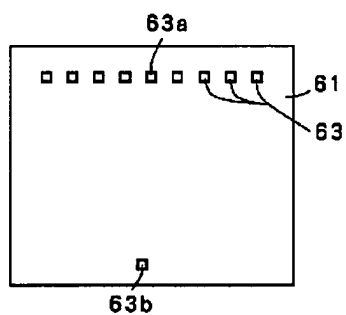


[Drawing 8]

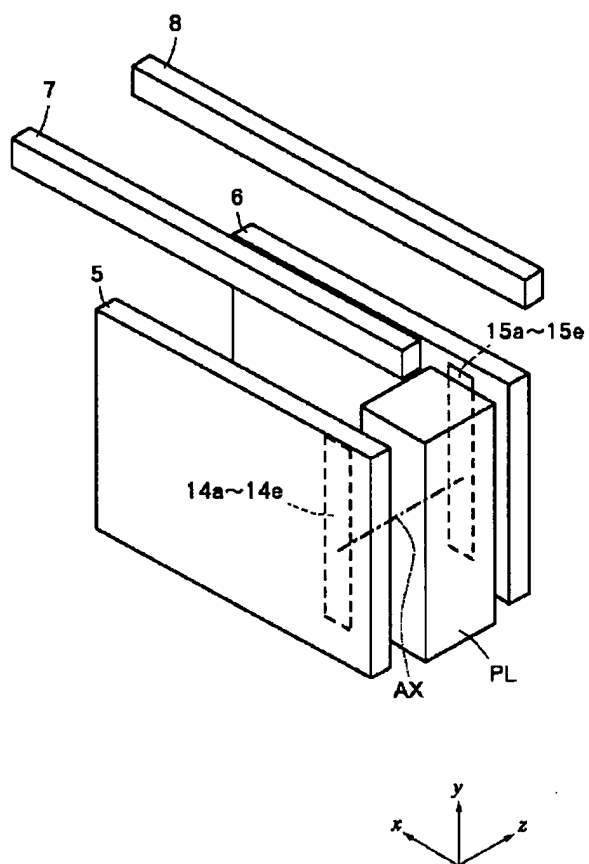
(a)



(b)



[Drawing 9]



[Translation done.]